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A STUDY OF THE MAXIMUM POLARISATION OF PLATINUM ELECTRODES.

IN determining the maximum polarisation in a voltameter containing dilute sulphuric acid, and furnished with electrodes of platinum, it is a matter of common observation that considerable discrepancies arise between the different determinations. The circumstances upon which the amount of polarisation might *a priori* be supposed to depend are chiefly the nature of the surface of the platinum electrodes, their dimensions, the state of concentration of the sulphuric acid, and indirectly upon the pressure at which the gases are evolved.

The solution of the various problems connected with the maximum galvanic polarisation of platinum electrodes in sulphuric acid has been approached by various investigators, and amongst others by Fromme. There is an excellent paper by this physicist in the *Annalen der Physik und Chemie*, series 2, Vol. XXXIII., pp. 80–128, in which he discusses the difficulties of the subject with much elaborate detail, and describes experiments of his own which were undertaken in order to throw some light upon the matter.

There are really two papers on this subject in the *Annalen*, the one quoted above appeared something more than a year ago. In this paper it may be remembered Fromme arrived at some important results. He found that the amount of polarisation varied in a most complicated manner, according as the strength of the dilute acid was varied.

In these experiments Fromme employed sulphuric acid, varying in concentration from 0·18 per cent. to 65·0 per cent., and he observed that as the strength of the acid is gradually raised, the polarisation increases till it reaches a maximum value, and then diminishes to a minimum value.

The influence of the dimension of the electrode is very remarkable, for when the anode is comparatively small the value of the polarisation passes through a second maximum and minimum, until it finally steadily increases in proportion to the increase in the degree of concentration. On the other hand, when the anode employed was larger Fromme failed to detect more than one maximum and minimum value for the polarisation.

The influence of the character of the acid was also examined. It was found that when the acid was very dilute the amount of polarisation depends upon whether the water used in diluting the acid has been boiled in glass or in metallic vessels. This remarkable fact is probably due to the presence of minute particles of glass or of metal in the water, and it forms a striking instance of the powerful influence of traces of foreign matter, concerning which, in another branch of science, we have heard so much lately from Prof. Roberts-Austen and Mons. Osmond.

When the cathode is of small dimensions it becomes blackened during the passage of the current of electricity, whilst this effect was not noticed when the size of the cathode was increased. The colour of this deposit was observed to be yellow when both electrodes were small, and the strength of the acid was still weaker. The black deposit referred to was first observed by De la Rive and by Poggendorff, and they showed that it consisted of tiny particles of platinum which had become mechanically detached from the surface of the cathode. Fromme's experiments appear to confirm this conclusion.

On the whole, it was found that the influence of the dimensions of the electrodes greatly affected the amount of the polarisation. With very dilute solutions the size of the anode appears to be the most important, whilst when stronger solutions were used the dimensions of the cathode were the most important.

The E.M.F. of polarisation varied with the dimensions of the electrodes thus: when both were large it varied from 1·94 to 2·43 of a Daniell, the strength of the acid employed varying at the same time from 0·18 per cent. to 68 per cent. With the same variation in the strength of the acid the E.M.F. varied from 1·45 to 2·98 when the cathode was small and the anode large; from 1·90

to 4·18 when both cathode and anode were small; and from 1·89 to 4·31 when the cathode was large and the anode small.

When the voltameter was traversed by a strong steady current the resistance was found to diminish as the concentration of the acid is increased; in this case the resistance reaches a minimum value when the degree of strength is about the same as that for which the conductivity is found to be a maximum by observation with alternate currents; after this, it is found to increase with any increase in the degree of concentration.

In the case where the anode is small the resistance of the voltameter continues to diminish up to the highest limits of concentration—namely, 65·0 per cent. used by Fromme in the experiments.

Since the paper embodying these results was published Fromme has been at work upon a further development of the subject; this last contribution to our knowledge of the maximum polarisation of platinum electrodes in sulphuric acid recently appeared in the *Annalen der Physik und Chemie*, second series, Vol. XXXVIII., pages 362–395. The description of the experiments may be read by those who wish to follow the author through the elaborate details of his method in the REVIEW for March 7th last.

Dublin Electric Lighting.

WE have received a copy of the Report of the Deputation named by the Electric Light Committee, of Dublin, to visit various installations for the supply of electricity. The stations inspected include the House-to-House Company's West Brompton works, the Cadogan Company's Chelsea depôt, the Chelsea Electric Supply Company's station, the Kensington and Knightsbridge Company's premises, the St. James's and Pall Mall Company's centre, the Sardinia Street station, together with the provincial stations of Exeter, Taunton, Bath, Southampton and Waterford.

Opinions of the Deputation.

THE Deputation considered that its members had fully acquainted themselves with the various methods now in use for generating and distributing electricity for lighting and other purposes, and these are commented upon in the following manner:—The low tension system, in which the E.M.F. is generally 100, but not more than 200 volts, and which is used by the St. James's and Pall Mall Company, and Kensington and Knightsbridge Company, has many advantages in small and closely populated wealthy districts, such as the portions of London in which the above companies have power to supply current. The storage or secondary batteries may be sufficiently charged with electricity during the day to last for the night, and the light supplied is absolutely steady when drawn from such batteries. There can, therefore, be no cessation of light through a break down of the generating machinery, as the batteries, if fully charged, will deliver the current to the consumers for several hours. The disadvantages of the low tension system are that the copper mains or leads conducting the current must be of very much greater sectional area than in the high tension system when the E.M.F. exceeds 1,000 volts. With low tension, moreover, it is practically impossible to maintain a uniform voltage on the mains over a large area. As may be seen from our report on the low tension stations, in addition to the mains carrying the supply of current, additional leads called feeders must be sent out to reinforce the current at various points, called either E.M.F. points or distributing points. This involves a network of mains and a large expenditure upon copper, and can only be remunerative in a small district where there is a large and concentrated demand for current. The depreciation of plant must also be great as the storage batteries require to be frequently cleaned and to be renewed in great part at least every three years, and a large staff of men must be employed to look after them. After giving the matter mature deliberation, your Deputation would recommend for street lighting the adoption of a continuous current, of 2,000 volts E.M.F., with arc lamps in series having opal globes. We would also recommend that three or four alternating dynamos should be fixed in the central station generating current at 2,000 volts, with transformers to reduce the voltage to 100, or thereabouts, in the houses of customers. We are of opinion that this system is the best adapted to the wants of a city like Dublin, where the area to be lighted is large and the customers scattered.

Central Station Recommended.

THE Deputation also recommended that the Committee should select a suitable site for a central station and instruct the Borough Surveyor to prepare plans and an open specification for laying down a proper plant for lighting the area named in the licence received from the Board of Trade. This has been done, and after having considered several suggestions, the Committee has come to a conclusion in favour of a site in Fleet Street, from whence we soon hope to hear that the good folks of Dublin are receiving large supplies of electrical energy.

Items of Interest.

THE Dublin deputation during its peregrinations gained some interesting information. Thus the House-to-House Company was, at the time of the visit, supplying 6,000 incandescent lamps which were expected to increase to 7,000 in a short time, and some Sunbeam lamps used in the Brompton station had been working for over 2,000 hours. Major-General Webber also made the following statement:—"Although the space required for a transformer is not theoretically large, in practice it is found that its installation is a more serious cause of expenditure and interference with structure than the advocates of its use lead us to suppose." . . . . "In 1887 I inspected one of the first installations under the system at Lucerne, and there I found the transformers in cupboards, and heating so as to colour the surrounding woodwork." . . . . "It is wrong to suggest that the installation of a transformer does not entail an expenditure much in excess of its actual cost." Apparently, from these remarks, the deputation concluded that the gallant Major-General is not a believer in the high tension alternating current for domestic supply. Mr. Crompton estimated that 1·6d. per unit is the cost of manufacture (to his company) delivered to the consumer, including coal, water, oil, labour and petty charges, but not including superintendence, rates, or taxes. From this it appears that upon these latter

charges being heavy or light, depends the profit or loss of suppliers of electrical energy at 8d. per unit; but why can we not get at some accurate statement of cost inclusive of everything? However, as the St. James's and Pall Mall Company expect to pay a dividend of 10 per cent., we imagine that the items credited to superintendence, rates and taxes, are not, in this instance, excessive. The Brockie-Pell lamps were the theme of much surprise and admiration, but if the deputation could just step in and observe the "Planet" small arc lamp in action, we fancy that they would have even more cause to be awe-struck with its steadiness and absence of flickering. "We were struck with the fewness of parts and simplicity of design of the Mordey Victoria alternating dynamo. These dynamos are easily repaired, and run perfectly in parallel; Mr. Mordey being the first to discover the fact that two, or any number of dynamos of the same size or periods, will synchronise and deliver a supply of energy through one lead." The Brush Company's electrician should experience the most lively feelings of gratitude at being thus immortalised; and, doubtless, others who had, or thought they had, performed the same feat, will bite their lips with chagrin. Nevertheless, the deputation seems to have been in earnest, and we hope that much good may come out of the information contained in the report.

Artificial Gutta-Percha.

"DR. PURCELL TAYLOR presents his compliments to the editors of the ELECTRICAL REVIEW, and begs to say that he has succeeded in making a new insulating material, having all the properties of gutta-percha, but with a higher dielectric resistance. The new substance (called "Purcellite") is very tough and elastic; it may be made any colour, either flexible or rigid. A piece of iron covered with Purcellite was hammered out flat, and bent and twisted until it broke without even cracking the insulating substance. Its cost is about $\frac{1}{10}$th that of gutta-percha." The above is a faithful copy of a missive sent to us, and it will doubtless cause much consternation amongst wire coverers. It would have been, however, more to the purpose if Dr. Purcell Taylor, whoever that gentleman is, had sent us, say, a few hundred feet of wire insulated by his newly discovered process; we could then have satisfied ourselves as to the pretensions he sets forth, which are not likely to be received amongst cable men in that credulous spirit for which the inventor doubtless hopes. We would suggest that he should introduce his ware to Mr. Ferranti.

To the *Scientific American*.

IN the last issue to hand of this journal we read the following editorial:—"On page 243 we give at some length the details of an improvement in the arc light which, according to the statement of Dr. John Hopkinson, has yielded results of a very important and valuable nature. The luminous power of the ordinary light is asserted to be nearly doubled, less energy is consumed, increased steadiness is gained, the quality of light improved, and other advantages gained. The improvement is effected in a very simple manner, to wit, by feeding to the lower carbon a minute quantity of hydrocarbon, in the form of an oil or grease. The further particulars given will no doubt be read with interest." Now the "further particulars" given are simply word for word those which were sent to the ELECTRICAL REVIEW some time ago, and which formed the subject of our leader for March 14th, and for the correspondence and leaderette which followed in the next number. It seems strange that a journal occupying such a position as the *Scientific American*, should insert an article, apparently on its own authority, teeming with absurdities and written by one deeply interested in the lamp. We call the attention of our American electrical contemporaries to this matter lest an attempt should be made to "boom" this marvellous arc lamp in the States.

The Admiralty Dynamo Specification.

Industries, in its issue of the 11th ult., falls foul of the Admiralty specification for dynamos. In an article of three columns, which may be justly characterised as much ado about nothing, the writer attempts to show to his own satisfaction that some of the clauses to which dynamo manufacturers must conform are most absurd. This would probably have been the case if the specification had been worded in the manner *Industries* has chosen to accept as correct, but Mr. Farquharson clearly proves that our contemporary, by careless perusal and the omission and insertion of words which materially alter the meaning, has assumed a basis which is not specified upon which to construct a theory, showing what must happen if the Admiralty tests are observed. It is not often that we come across such a complete refutation of ideas which could have only been propounded in ignorance of the real facts under consideration. This being the case, we utterly fail to see the force of our contemporary's foot note to Mr. Farquharson's reply, which reads as follows:—"We wrote carefully, and we do not find anything in Mr. Farquharson's letter to lead us to alter our views. We shall be glad to have the views of some of our readers on the subject." Instead of asking readers to forward their ideas, it would have been more courteous and dignified to have admitted that after the facts had been correctly stated the article in question was open to modification.

How it is Done.

A VICTIM to electropathic belt quackery called upon us during the week. This young man was treated for rupture, and after spending nearly twenty-five pounds on worthless appliances without receiving that relief and perfect cure which he was led to believe would unfailingly result he demanded his money back. Unfortunately he was induced to "square" the matter for a £10 note, a proceeding which he now regrets. The manner in which the vendors of these belts attempted to combat the young man's claim may be judged from the following copy of a letter received by him:—"I am instructed by the directors of this company to inform you that the goods in question were purchased of the *late* . . . Company, Limited [the two companies having precisely similar titles.—EDS. E. R.], and we, their successors, have every reason to believe that the appliances you bought of them were good. The present company cannot therefore open the affairs of their predecessors.—SECRETARY." This, we may add, was written after previous correspondence upon the subject, in which it was stated "it is contrary to our rules to take back appliances or instruments which have been in use."

ELECTRICAL OSCILLATION.

RECENTLY Dr. Oliver J. Lodge, F.R.S., Professor of Physics in University College, Liverpool, delivered a lecture on "Electrical Oscillation" to the members of Glasgow Philosophical Society. The meeting was held in the Natural Philosophy Class-room of the university, and there was a very large attendance, but we cannot guarantee the accuracy of this report, which was sent to us by a correspondent. Prof. M'Kendrick presided.

Prof. LODGE began by calling attention to the essential conditions required for oscillation. One was elasticity, or at least some kind of restoring force, so that when a body was displaced it should tend to return to its position of equilibrium, and the other condition was inertia, whereby a body might be carried past its position of equilibrium, when it would set up a restoring force in the opposite direction. This was illustrated by an experiment with a U tube, in which the vibrations of water were shown. A number of interesting experiments were given with four Leyden jars of very great electrostatic capacity, discharged under various conditions. The sparks were discharged into water and under water. Those directed at the surface spread out into curious figures, and when the discharge took place in a tumbler of water the glass was broken in virtue of the water acting as a dielectric. It was not very clearly understood, the lecturer said, that a good conductor offered great resistance to oscillatory currents of great frequency. In proof of this he took a copper wire whose ordinary resistance would be the hundredth or the thousandth of an ohm, but whose obstruction or impedance might be very much greater—perhaps something like 100 or 1,000 ohms. He found that to drive an electrical current through this conductor required a difference of potential which was enormous. He then showed the experiment of the alternative path, an experiment which he himself had devised in connection with his well-known researches on lightning conductors. It demonstrated that a flash of electricity might leave even a good electrical conductor and jump a moderate air space if the impedance of the conductor were sufficiently great. He also exhibited conductors of various thicknesses of wire, and showed that the size made but little difference on the effect, but that when iron wire was used the current maximum reached was a little less than in the case of copper wire. The current did not flow through the whole substance of the conductor. It cast merely a superficial thin film over the surface of the iron wire, and in consequence the damping was more rapid and the impedance was rather less than in the case of the copper. Therefore a lightning conductor made of iron might be actually superior to a copper one. The Leyden jars having been charged as in the former experiments, they were made to discharge through a long copper wire which had been hung round the lecture room. The oscillation set up in the wire reacted in the jars with an effect which, the lecturer explained, was quite similar to the surging of water in a flat bath when the edge of it was tilted up. If the disturbance was sufficiently great the water would splash over. So it was in the case of the jars. The spark overflowed or splashed over the edges from the inside to the outside coatings. This effect depended on having a long wire. On substituting a shorter wire splashing over did not so readily occur. When oscillation took place in a medium possessing the necessary properties that medium was thrown into oscillation likewise, into what were called waves. Thus, for instance, a steel spring vibrating in air carried the surrounding air into waves. Two tuning forks tuned to the same note were shown, and the vibrations excited in the air by one of them was taken up by the second fork, which acted as a resonator. The lecturer asked was there anything analagous to that in electricity? According to Clerk Maxwell there was. Electric oscillations occurred in the medium, luminiferous ether, which, according to his theory, possessed rigidity and inertia, or something analogous to density. Clerk Maxwell, however, was not able to verify his theory, but this had now been done by the experiments of Hertz, whose detector was exactly analogous to the second resonant fork. If two Leyden jars were tuned alike oscillations in one would set up oscillation in the other. Two exactly similar jars were shown with similar conducting circuits connected to their inside and outside coatings. One of these was connected to an electrical machine and caused a spark, and the other, which was wholly disconnected from the first, exhibited phenomena of sparking by electric resonance. These vibrations, it was explained, were comparatively slow, the rate of vibration he imagined to be about half a million a second. In this case the waves would be about 60 metres long. The modes of lengthening and shortening vibrations were then exhibited. Hertz's vibrators were shown. By their means very short vibrations were obtained. The longest waves which had been got were something like 1,200 miles, and the rate of oscillation corresponding to them was 125 per second. But Hertz obtained much smaller waves than these, and he did so by diminishing the capacity of the jar. The lecturer then exhibited a Hertz vibrator excited by a Rhumkorf coil and explained the rapid fading away of the vibrations, pointing out that the energy of these vibrations was due principally to the emission of the waves into the surrounding medium. It was the ether itself that took up nearly the whole of the energy and transmitted it forward into space. He reckoned in the case before him that the radiation was about 100 H.P. For the comparison of these vibrations with the vibration of light, he said they had been submitted to every test which had been applied to luminous vibrations. They had been reflected on metallic surfaces, they had been refracted through lenses, for which purpose great lenses of pitch had been used. There had also been obtained interference phenomena, and, lastly, the phenomena of polarisation. Returning to the question of the shortening of vibrations, the lecturer showed spheres of different sizes, and explained that the time of oscillation of electric disturbance on a metallic sphere was equal to the time taken by light to travel 1·4 times the diameter of the sphere. By using brass balls of small diameter he had been able to obtain waves of not greater length than three inches. Although one could not realise it, they could imagine passing on to vibrations of electricity on the molecules of matter, and in this connection he exhibited a very beautiful phosphorescent vacuum tube in which there was strontic sulphide, a little fluor spar, and a trace of copper. An electric charge was passed over the powder in the tube, which emitted a brilliant green light, which the lecturer said he believed would become the light of the future, although there was in the present case a light of only half a candle-power. The lecturer concluded by exhibiting an arrangement of conducting lines on the surface of a glass plate, which lines he compared to the rods and cones in the retina of the eye. He imagined the rods and cones to be tuned to receive the luminous vibrations as the lines on his glass plate were tuned to receive the electric vibrations. So it seemed to be that they had there the beginnings of a theory of vision. According to it the rods and cones constituted a sort of Cortis's organ, and the different colour sensations corresponded to the different chambers of the retinal bodies. There was much yet to be worked out, and in particular the doctrine of these primary colour sensations appeared to become on this view somewhat strained and improbable, unless, indeed, physiologists were able to find three distinct sizes or kinds of rods and cones in the retina. Physically it was certain that three colour sensations were sufficient to explain normal vision, but physiologically it had to be shown that no more than three actually existed. The electric theory of vision at first sight appeared to lend itself more simply to a doctrine of an infinite number of colour sensations corresponding to the infinite series of the visible spectrum. The subject of electro optics had hitherto been a somewhat narrow field among the workers, in which, by the way, one of the citizens of Glasgow, Dr. Kerr, stood eminent; but in the light of recent work, this narrow field showed signs of opening into a wide and fertile

region, offering easy returns for a moderate outlay of education and experiment.

Prof. M'KENDRICK said they had been in the habit of saying that we had no electric organ, no instrument by which we could detect electric phenomena; but after the explanations which they had had that night, they began to see that that was an artificial way of treating the matter, that what were called light waves were short electric waves, and that we had an organ which could detect those waves which we had been in the habit of talking of as light. The electric origin of sight, he had no doubt, would receive the careful attention of physiologists.

Sir WILLIAM THOMSON said the ancients had what had been called the music of the spheres. Dr. Lodge had given the meeting what might be called the music of ether. He well remembered when the subject of electrical oscillation began first to grow in the minds of those who had been thinking of it. This was at the meeting of the British Association at Southport. The question was put before the members in an informal discussion, and they were asked to think of waves quicker than the shortest audible waves of sound which correspond to 10,000 or 20,000 periods per second. At that meeting Fitzgerald hazarded the bold opinion that electric oscillations might fill up the gap between the highest audible vibrations of 20,000 per second, and the lowest luminous vibrations 100 million per second. The researches of Hertz and Lodge had realised what was then nothing more than a splendid speculation.

Prof. LODGE thanked the audience for their attention, and said he desired to return his special thanks to Sir Archibald Campbell for the great assistance he had given by lending apparatus, and helping in the preparations for the evening's lecture. The electrical machine that had been used was one that had been constructed by Sir Archibald, who presented it to the university some months ago.

The proceedings then terminated.

ON CURRENT DISTRIBUTION IN NETWORKS OF ELECTRICAL CONDUCTORS.

By I. HERZOG and L. STARK, Buda-Pest.

(*Concluded from page* 424.)

NEXT to this, we will take into consideration the case where several conduits meet at two "knots" or points

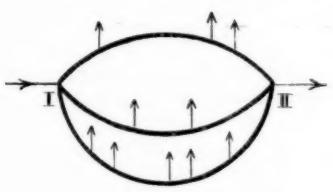


FIG. 9.

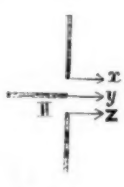


FIG. 10A.

of junction I and II (fig. 9). The current may enter at I and depart at the different embranchments as well as at the point II.

The calculation of the current distribution shall again be shown as an example in numbers, represented by fig. 10. It will be noticed that from one of the branches, 50 mm² in section, no current is taken, the branch thus serving as an auxiliary conduit. In this case it is best to imagine the junction undone at II, for it is easier to set up the equations for this point, than for the case where the highest and the lowest branches are cut. The equations are:

$$x + y + z = 60 \qquad \text{(I.)}$$

$$x\frac{200+200+100}{300} + 200\frac{200+100}{300} + 50\frac{100}{300} = y\frac{200}{50} \qquad \text{(II.)}$$

$$z\frac{670+180+50}{120} + 120\frac{180+50}{120} + 30\frac{50}{120} = y\frac{200}{50} \qquad \text{(III.)}$$

whence

$$\begin{cases} x = 5{\cdot}7 \text{ amps.} \\ y = 56{\cdot}5 \quad \text{,,} \\ z = -2{\cdot}2 \quad \text{,,} \end{cases}$$

We find that the auxiliary had transferred 56·5 amps. to the knot II; that, furthermore, 2·2 amps. return

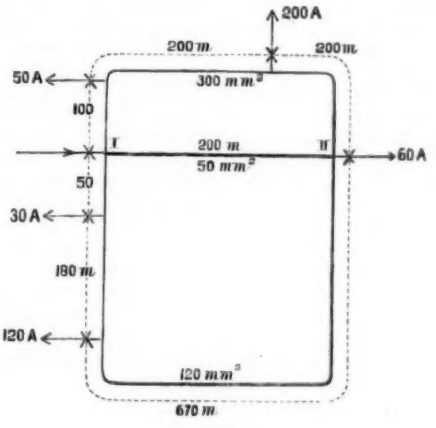


FIG. 10.

by the lowest conductor from II to 4. Hence a view of the correctly cut network is represented by fig. 11.

FIG. 11.

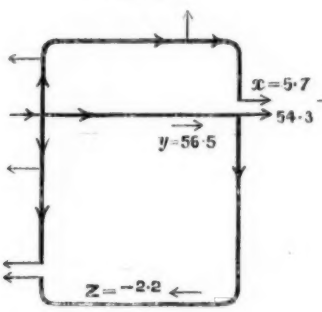
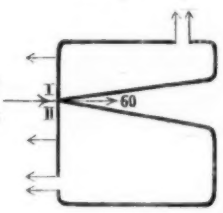


FIG. 12.



A question which affords much interest is what influence the size of the section of the auxiliary conductor exerts upon the current distribution. Denoting the sectional area of this lead by f, the following equations are obtained:

$$x + y + z = 60 \qquad \text{(I.)}$$

$$1{\cdot}67\,x + 216{\cdot}66 = \frac{200\,y}{f} \qquad \text{(II.)}$$

$$7{\cdot}5\,z + 242{\cdot}5 = \frac{200\,y}{f} \qquad \text{(III.)}$$

whence, for the three unknowns, expressions of the following form result:

$$\begin{cases} x = \dfrac{\mathrm{M}f - \mathrm{N}f^2 + o}{o\,f - \mathrm{Q}f^2 + s} \\ y = \dfrac{\mathrm{A} - \mathrm{B}f}{\mathrm{C} + \mathrm{D}f} \\ z = \dfrac{\mathrm{G}}{\mathrm{H} + \dfrac{\mathrm{K}}{f}} \end{cases}$$

From these equations we find for:

$f = 0$	$f = 50$ mm²	$f = \infty$
$x = 51{\cdot}9$ amps.	5·7 amps.	− 129 amps.
$y = 0$,,	56·5 ,,	221·2 ,,
$z = 8{\cdot}1$,,	− 2·2 ,,	− 32·2 ,,

From these values it may be seen that by a diminution of f, the current x becomes greater and y smaller, whilst z first decreases, then becomes nought for a certain value of f ($= 110{\cdot}5$ mm²) and afterwards increases again. By increasing f above 50 mm², x first becomes smaller, then passes through zero and afterwards increases again to a maximum of $-$ 129 amps.; at the same time y attains a maximum of $+$ 221·2 amps. and z amounts to $-$ 32·2 amps. A complete interruption of the auxiliary lead would therefore bring x to about 52 amps. and z to about 8 amps., whilst with an infinite section of the auxiliary lead, x would amount to $-$ 129 amps. and z to 32 amps. In the first case, the true cutting point would exist, one in the upper conduit at 2 and one in the lower at 4. The physical meaning of $f = \infty$ is that points I and II are joined into one (fig. 12). The network is thus reduced to two ring conduits.

The question may be raised, how the cut is to be imagined through a point of junction such as II in fig. 13, where no current consumption takes place. This means only that the departing current $= 0$. The cut may therefore be placed in a manner similar to that in the former case, viz., we imagine the three conduits meeting at II, separated as shown in fig. 13*a*, call the currents in two of them x and y, whence the third current must be equal to $-(x+y)$, as $x + y - (x+y) = 0$. For the two unknowns we set up two equations one of which expresses that the loss of potential from I over i_4 to II, is equal to that from I over i_3 to II, whilst the second signifies that the loss of potential of A over I, and i_1 to II amounts to the same as that from A over the right side conduit to II.

$$x \cdot \frac{150+100}{30} + i_4 \frac{100}{30} = y\,\frac{50+150}{150} + i_3 \frac{150}{150} \qquad \text{(I.)}$$

$$-(x+y)\frac{200}{180} = y\left(\frac{50+150}{150} + \frac{100+200}{180}\right) + i_3\left(\frac{150}{150} + \frac{100+200}{180}\right) + (i_2+i_4+x)\frac{100+200}{180} + i_1\frac{200}{180} \qquad \text{(II.)}$$

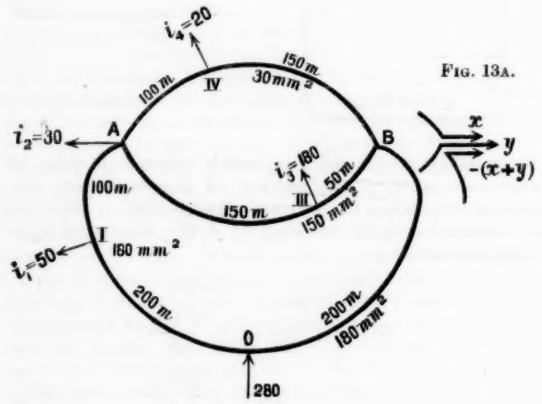


FIG. 13A.

FIG. 13.

whence:

$$\begin{cases} x = \dfrac{30\,i_3 - 80\,i_1 - 108\,i_2 - 848\,i_4}{2{,}038}, \\ y = \dfrac{-500\,i_1 - 675\,i_2 - 1{,}341\,i_3 - 205\,i_4}{2{,}038}. \end{cases}$$

Substituting the numerical values for i_1, i_2, i_3, i_4, we obtain:

$$\begin{cases} x = -\ 9{\cdot}2 \text{ amp.} \\ y = -\ 142{\cdot}5 \text{ ,,} \end{cases}$$

To reach the real points of cutting we have to proceed from x and y towards the point of junction III, and find them at i_3 and i_4 (fig. 14).

It may be noticed that of the expresions for x and y, the denominators are the same, the numerator of x being composed of positive and negative items, whilst that of y contains only negative items. We may reason therefrom, that x reaches its positive maximum, if the negative parts become $= 0$, and its negative maximum if the positive parts become $= 0$.

In the first case

$$\begin{aligned} i_1 &= 0\,; \\ i_2 &= 0\,; \qquad x_{max} = +\ 2{\cdot}3 \text{ amps}\,; \\ i_4 &= 0\,; \end{aligned}$$

in the second, however,

$$i_3 = 0\,; \qquad x_{max} = -\ 11{\cdot}9 \text{ amps.}$$

The current, y, possesses a negative maximum only, equal to that calculated $= -\ 142{\cdot}5$ amps.

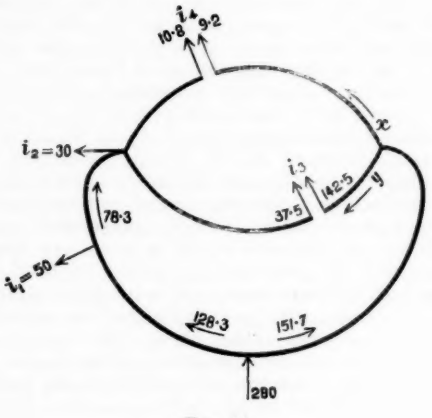


FIG. 14.

To find the highest intensity possible in the lead A_{II}, we have to find the maximum of $(x+y)$, which is

$$x + y = \frac{-848\,i_4 - 108\,i_2 - 80\,i_1 - 500\,i_1 - 675\,i_2 - 205\,i_4 - (1341-30)\,i_3}{2{,}038} = -151{\cdot}7$$

the same current which circulates when all the points of current consumption are fully loaded.

The current in the lead I $i_4 = i_4 + x$ attains its maximum value when x has its highest positive value $= +\ 2{\cdot}3$. Then the maximum for the current in I i_4 equals $20 + 2{\cdot}3 = 22{\cdot}3$ amps.

The current in I i_3 is

$$i_3 - y = i_3 - \frac{500\,i_1 + 675\,i_2 + 1341\,i_3 + 205\,i_4}{2{,}038}.$$

Therefrom we find for the negative maximum $i_3 = 0$, and $i_3 - y = -\ 24{\cdot}2$ amps., and for the positive

$$\left.\begin{matrix} i_1 \\ i_2 \\ i_4 \end{matrix}\right\} = 0 \text{ and } i_3 - y = +\ 61{\cdot}6 \text{ amps.}$$

The current in A i_1 is

$$i_1 + i_2 + i_3 + i_4 - x - y = \frac{1458\,i_1 + 1255\,i_2 + 727\,i_3 + 985\,i_4}{2038}.$$

The numerator contains only positive products of all the consumed currents which infers that the current in question has only a positive maximum existing when all the points of current consumption are fully loaded. Its value is equal to that noted in fig. 14 already $= 128{\cdot}3$ amps.

Gathering all the results of these inquiries for the maximum values of different currents we see that the currents in the leads A_I and A_{II} have positive maxima with regard to the knots I and II as soon as all the current consumers are connected; with this current consumption y reaches its single negative maximum within the part I i_1. Current x in II i_4 reaches its positive maximum with regard to II if all the current consumers except i_3 are disconnected; at the same time the currents in I i_4 and I i_3 are at their positive maxima.

The latter current as well as x besides have a negative maximum (with regard to i_4) as soon as $i_3 = 0$.

Before concluding we will, by aid of a network with five knots (fig. 15), give some general remarks pertaining to the principles how to proceed in order to find the maximum currents circulating in the different leads by consequence of some groups of current consumers being disconnected. To examine these relations, it was customary to have a reproduction made of, and in proportion to the network in question, and to study the influence of fluctuations in the current-consum experimentally at this model. Many tenders still require the addition of such a model, a token how little this problem has been studied so far.

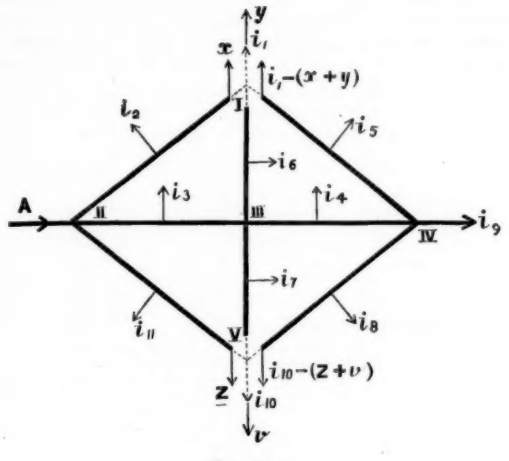


FIG. 15.

In fig. 15 it will be most simple and discernible to cut the knots I and V. In this way four unknowns will result, for which four equations may be set up by noticing that the tensional loss

on the way I_2 II equals that on the way I_6 III_3 II

" " I_2 II " " " I_5 IV_4 III_3 II,

" " V_{11} II " " " V_7 III_3 II,

" " V_{11} II " " " V_8 IV_4 III_3. II.

The form of these four equations is :

$$\left.\begin{aligned} r_{11}x + r_{12}y + r_{13}z + r_{14}v &= \Sigma\,(i_n f_1(r)) = a_1 \\ r_{21}x + r_{22}y + r_{23}y + r_{24}v &= \Sigma\,(i_n f_2(r)) = a_2 \\ r_{31}x + r_{32}y + r_{33}y + r_{34}v &= \Sigma\,(i_n f_3(r)) = a_3 \\ r_{41}x + r_{42}y + r_{43}y + r_{44}v &= \Sigma\,(i_n f_4(r)) = a_4 \end{aligned}\right\}$$

where r_{11}, r_{12}, r_{13}, ... r_{44} are only sums of given resistances of leads and $\Sigma\,(i_n f_m(r))$ denote sums of products of variable consumed currents, i_n into algebraical functions, $f_m(r)$, of invariable resistances of leads. As it is well known, we can find from these equations :

$$x = \frac{\begin{vmatrix} a_1 & r_{12} & r_{13} & r_{14} \\ a_2 & r_{22} & r_{23} & r_{24} \\ a_3 & r_{32} & r_{33} & r_{34} \\ a_4 & r_{42} & r_{43} & r_{44} \end{vmatrix}}{N},$$

and y, z and v in the same way. N is a determination common to all four unknowns and formed at their coefficients, therefore not depending upon the current-consumptions. The numerator, however, contains the sum of products which stand upon the right side of the equations and solely depend upon the current-consumptions. Thus the maximum values of the currents x, y, z and v coincide with the maxima of the numerator determinant. We may again write

$$\left.\begin{aligned} x &= \frac{1}{N}\,\Sigma\,[i_n\,F_1(r)], \\ y &= \frac{1}{N}\,\Sigma\,[i_n\,F_2(r)], \\ z &= \frac{1}{N}\,\Sigma\,[i_n\,F_3(r)], \\ v &= \frac{1}{N}\,\Sigma\,[i_n\,F_4(r)]. \end{aligned}\right\}$$

From these equations the influence of a variation of one or several currents, i, upon x, y, z and v may be reckoned. In general, however, only the maximum values of these currents are of interest. To find these in a simple manner, we arrange the $\Sigma\,[i_n\,F_m(r)]$ in two parts of which one contains only the negative, the other only the positive items ; according as we take either the positive or the negative part = 0, we obtain the negative or positive maxima of the currents, x, y, z and v. The maximum currents in the other parts of the mains may be found by writing down the values of these currents, dividing into a positive and negative part as above and taken one of these parts equal zero—or by using in the expressions for these currents directly the maximum values of x, y, &c.

The examples quoted and reckoned over in the above will certainly suffice to make the employment of this *method of cutting* upon the calculation of current distribution in given networks intelligible.

In a few sentences the method described above may be put down as follows :—

(1) Imagine the given network cut at any point of derivation or junction in such a way that it is divided solely into open nets, and that no part of any conductor be without connection with one of the feeding points.

(2) Regard the currents flowing within the parts of conductors to or from the cutting points as unknown x, y, z . . . set up the equations and solve them for these unknowns. The obtained values are the real ones, and at the same time indicate the direction of the unknown currents.

(3) The real cutting points are found by proceeding in the direction of the currents, calculated according to 2, so far as to reach points in regard to which both the currents are positive.

(4) After cutting the network at the so found points calculate the numerical values of the tensional loss which is maximum at the said points.

(5) To find out the influence of any change in the sectional area of any conductor parts upon the current distribution we arrange the expression for x, y . . . . with regard to the sections and then discuss them.

(6) To determine the influence of changes in the current consumption upon the distribution of current, we arrange the expressions for x, y . . . . as well as those for the currents in the other parts of the mains with regard to the current consumed. To find the positive or negative maxima we take the negative or positive parts = 0.

BENEST'S SUBMARINE CABLE GRAPNELS.

THE object of these grapnels (the invention of Capt. Benest of the India Rubber Company, Silvertown) is to enable a submerged cable not merely to be hooked but to be gripped or held fast when hooked. The advantages of such a grapnel are manifest, inasmuch as there will be no slipping of the cable on the flukes, and if a loose end is caught it cannot escape from the grapnel.

The essential feature of the invention is the conversion of the flukes into automatically acting gripping jaws. The stem or shank of the grapnel is fitted with a boss which forms a guide for leading the hooked cable into the position to be gripped. Below this boss the shank is fitted with a thick plate carrying forked extensions standing out radially for the reception each of a fluke which is pivotted thereto. These flukes may be described as bell crank levers, the short arms of

which are intended to receive the pressure of the cable as it is caught, and thus cause the flukes which are in action to rise from their open position and close upon the cable, and grip it against the boss of the grapnel. By this arrangement it will be understood that the act of hauling in the grapnel will have a tendency to increase the grip of the grapnel upon the cable which it has caught.

Fig. 1 shows in side elevation a grapnel of the simpler form, and fig. 2 is a portion of the grapnel showing one of the flukes in the gripping position. A is the stem or shank of the grapnel, which carries at its lower end a boss, B, conveniently made of cast steel, and secured to the stem, A, by a lock nut. This boss is ribbed, as at *b*, to form inclined shoulders, which constitute the fixed gripping jaws of the grapnel. Below these ribs the boss extends laterally, forming five forks, b^1, which serve as supporting arms for the pivotted flukes, C. These flukes, which are pointed at their outer ends and

FIG. 2.

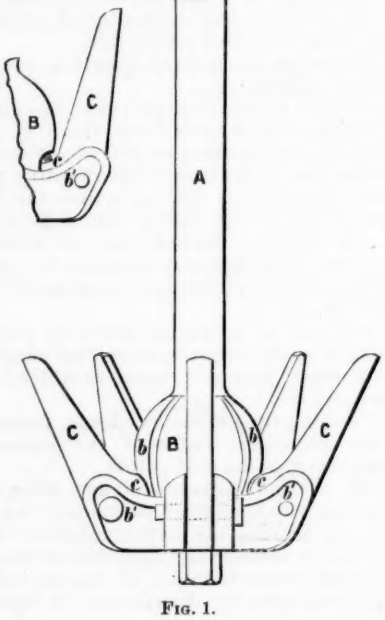


FIG. 1.

form the pivotted gripping jaws, take somewhat the shape of a bell-crank lever, that is to say, their rear ends extend inwards beyond the centre of motion of the fluke, and when depressed, cause the upper part of the fluke to advance towards the fixed gripping surfaces to which they are respectively opposed. The upper surface, *c*, of the tail end of the fluke is intended to receive the cable which is underrun by, say, two of the flukes, C. As the cable caught by the grapnel, while being drawn over the sea bottom, slides over the flukes, it will be caused to press upon the surface, *c*, of the tail end of the fluke, and by so pressing, to tip the fluke into the position of fig. 2, by which means the cable will be automatically gripped between the fluke, C, and the boss, B, of the grapnel.

On the hauling in of the grapnel, the bite on the cable will be not only maintained, but increased, and thus the tendency of the cable to slip, even though a loose end only is caught, will be removed. In some cases, however, where, for example, the hauling in is, from circumstances beyond the seaman's control, irregularly continued, the grapnel, by dropping, may lose hold of the partially raised cable, which, on getting above the level of the fluke pivots, will have no tendency to remain within the grasp of the grapnel.

It is to avoid this that the modification shown by fig. 3 has been devised. Fig. 3 shows in side elevation, partly in section, the improved automatic grapnel fitted with a locking device. In this arrangement, instead of using the fixed gripping surfaces, *b*, forming part of the boss, B (fig. 1), a second movable jaw, D, is provided, which, like the fluke, C, is pivotted within the supporting arms, b^1, extending horizontally from the boss, B. The jaws, D, are severally connected with their respective flukes, C, by interlocking teeth, which ensure the simultaneous approach of the jaws, C and D, to grip the cable when the pressure of the hooked cable comes upon the surface, *c*, of the tail of the flukes. Each jaw, D, is slotted longitudinally to receive a locking pawl, *d*, and a tumbler, d^1, situate below the pawl, and designed to move it into its locking position and retain it therein. These pieces, *d*, *d*, are pivotally connected to the jaw, D, and the end of the pawl, when in its locking position, enters a nick in the gripping face

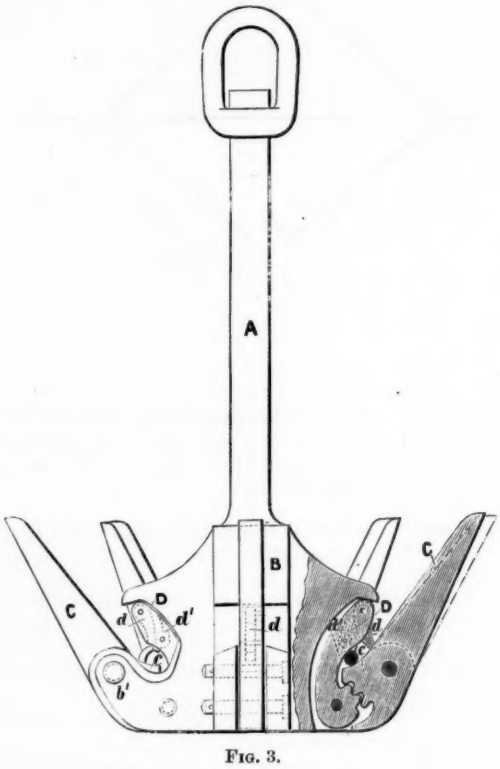


FIG. 3.

of the fluke, C. The tumbler is so formed that, when not in action, its lower end will project somewhat from the gripping face of the jaw, D, as shown on the left hand side of fig. 3. This is for the purpose of enabling the cable, as it slides in between the gripping surfaces, to tip the tumbler, D^1, and thereby bring into position the locking pawn, *d*, as shown at the right hand side of fig. 3. In order that the cable, whilst being hooked, may not be caught and lodge upon the top of the jaw piece, D, the cast boss is formed with a web which projects so as to cover said jaw piece. It will now be understood that the cable caught by the grapnel, and brought within the grip of the jaws, C, D, will be effectually prevented from escaping therefrom until released by hand after the recovered cable is secured.

A Heavy Suit.—J. W. Mackay, the California millionaire, has entered a suit in the Superior Court of Suffolk County to recover a judgment for $287,313.36, accorded to him by the Superior Court of New York in a suit brought by him against the Commercial Telegraph Company.

WYNNE'S URBAN ELECTRICAL TRAMWAYS.

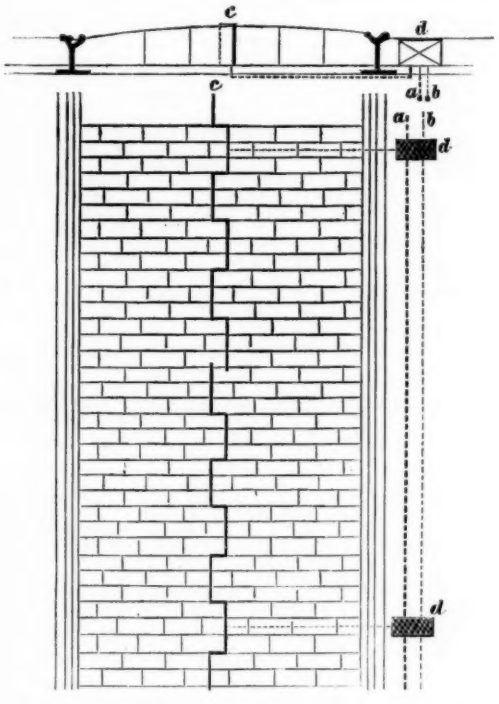
THE systems hitherto employed for applying electricity to the working of tramways in cities, that is, to urban tramways, as opposed to suburban, have been three in in number :—

1. By means of self-contained cars carrying batteries stored with electricity.

2. By means of a naked conductor of electricity carried in an underground channel, communicating by an open slot with the street, the connection between the running car and the conductor being by means of an arm through the slot ; in fact, almost identical with the wire rope tramways as used at Highgate and Birmingham.

3. By means of a naked conductor of electricity carried overhead, and supported at intervals along the street over the tramways line, by gibbet-like projections, on telegraph poles, and known as the "overhead" system.

This last is the system which has obtained such enormous development in America during the last few years ; it is unquestionably the system best suited for



suburban traffic, where conductors over and crossing the streets are admissible or permitted ; and it is for working in connection with this system, *and from one and the same source of electricity*, that Wynne's system has been devised—that is, the suburban traffic may be appointed, or continued to work on the "overhead," but when the line enters a town where telegraph poles and overhead conductors along, and crossing, the street are inadmissible, these shall stop short, and the conductor *continued* as an insulated underground conductor communicating with the moving car, by the method invented and introduced by Mr. Wynne.

This method, which was reported upon recently by the engineers of the Brush Electrical Engineering Company (see REVIEW for February 28th), is such that *all openings in the street pavement are dispensed with ;* there is no hole or place into which road grit and sludge can get, where it would abrade the conductors and require drainage or catchpits for its removal or collection. The only surface difference between an ordinary tram-line and one laid on Wynne's system, is that a crenellated flat iron bar is laid edgewise along the centre of the track following the bond of the paving sets, and certain contact boxes of about one-quarter of a square foot surface are spaced along line, and laid level with the pavement.

The accompanying plan of the road shows the above arrangement :—(*a*) indicates the underground insulated main conductor of electricity ; (*b*) is a small supplementary line, shown separate from the main conductor, but which may be incorporated with it, the two being laid like an ordinary electric lighting main ; (*c*) are the lengths of crenellated plates, which are made of such length that two or three of them at a time are covered by the moving tramcar ; (*d*) are the contact boxes.

The object of giving a crenellated shape to the iron bar laid edgewise is (1st) to bond and incorporate it with the pavement ; (2nd) to avoid break of bond, which is as important to preserve in pavement as in brickwork ; (3rd) to afford a good foothold for horses ; and (4th) to avoid any skewing of the wheels of vehicles in crossing the track.

The electrical arrangement is as follows :—Two lengths of *c* are always electrically charged *under* the tram-car, by being connected through the operation of the automatic contact boxes with the main ; and from these charged conductors the car, which is provided with an electro-motor, picks up the electricity as it proceeds by means of a brush sliding along the top of *c ;* as the car proceeds the lengths of *c* in advance are consecutively charged, and those behind are dropped, so that every charged length of *c* is always *underneath the car*, which thereby protects the ordinary traffic of the street from being by any possibility included in the electrical circuit.

As the electrically charged lengths of *c* are so short, the waste of electricity is reduced to a minimum, and no extraordinary or special insulation of these lengths is required ; they and the setts are well laid in the ordinary pitch grouting which is now so generally used for the best city pavements. The line can be flooded without any disturbance of its action.

By coupling both wheels of the tram-car, gradients of one in eight can be climbed.

One of the chief advantages of this system is that no reconstruction of the permanent way of horse-car lines is required, as the weight in each axle is only very slightly increased (the total weight moved is actually less than in horse lines), and further, a line worked by horses can be altered to electrical driving without interruption of the traffic. The cost of the alteration, as shown by the report previously mentioned, is hardly more than the capital cost of the horses and horse-cars which are dispensed with.

ON THE EXCITEMENT OF ELECTRICITY AND HEAT IN ELECTROLYTES.

By MAX PLANCK (*Annalen der Physik und Chemie*).

(*Continued from page* 455.)

Section 5.—Another Calculation of the Production of Heat.

ACCORDING to the principle of energy, the transformation of energy, or, in our case, the production of heat in any spacial part of the solution, must be equivalent to the value of the work of the effects exerted upon this space from without. These effects in our case consist firstly, in electrostatic work, by which the electricity generally leaves the space with a different tension than it had on entering ; and further, in osmotic work, whereby the ions of the space are either compressed or allowed to expand. Both kinds of work occur on the entire surface of the space and can be readily indicated.

The electrostatic work is measured by the product of the quantity of electricity which has passed through, into the amount of the electric tension through which it has fallen. Thereby, as the quantity of electricity, $\int v \, d\sigma \, dt$, enters the space in the time, dt, through a

surface element, $d\sigma$, with the internal normal, ν, we obtain the expression :

$$d\,t\int \mathrm{J}\,\nu\,d\sigma$$

as the amount of the electrostatic work. On the other hand, we obtain the osmotic work in the superficial element, $d\sigma$, for a given kind of ion by multiplying the osmotic partial pressure by the decrease of volume of the space which is produced by the movement of $d\,t$, $d\sigma$, and the normal component of velocity as calculated in section 1. Thus for the osmotic work performed at the positive ions of the first kind, we have

$$p\,.\,d\,t\,.\,d\sigma\left(-\frac{\mathrm{R}}{p}\frac{\delta p}{\delta \nu}-\varepsilon\frac{\delta \phi}{\delta \nu}\right)u$$

$$=-d\,t\,.\,d\sigma\left(\mathrm{R}\frac{\delta p}{\delta \nu}+\varepsilon\, p\frac{\delta \phi}{\delta \nu}\right)u$$

and corresponding expressions for the remaining positive ions. For the negative ions of the first kind the osmotic work is :

$$-d\,t\,.\,d\sigma\left(\mathrm{R}\frac{\delta \phi}{\delta \nu}-\varepsilon\,\phi\,.\frac{\delta \phi}{\delta \nu}\right)v\,.$$

so that we finally obtain the entire osmotic work by addition in the form :

$$-d\,t\,.\,d\sigma\left(\mathrm{R}\frac{\delta(\mathrm{U}+\mathrm{V})}{\delta \nu}+\varepsilon(\mathrm{U}-\mathrm{V})\frac{\delta \phi}{\delta \nu}\right)=d\,t\,d\sigma\,\mathrm{R}\,\mathrm{N}\,\nu$$

where $\mathrm{N}\,\nu$ is defined by the equation (2).

If $\delta\sigma$ is integrated over all the superficial elements and added to the electric work the total amount of the value of the work of the external effects and consequently the heat produced in the space in question appears as :

$$\mathrm{W}=d\,t\int d\sigma\,(\mathrm{R}\,\mathrm{N}\,\nu+\phi\,\mathrm{J}\,\nu) \qquad (11)$$

identical with the expression at the close of the last paragraph obtained in the direct way. The principle of energy is thus fulfilled by the assumptions which we have made.

The strikingly simple form of the expression for the osmotic work leads to a special consideration. We obtain the heat produced by the osmotic work in any given spacial part of the liquid if we totally disregard this work and merely assume that every gramme ion (whether positive or negative), carries with it in its movements the quantity of heat, R, which at 18° = 568·9 grm. calories. Since as by the element, $d\sigma$, altogether $d\,t, d\sigma$, $\mathrm{N}\,\nu$ ions enter the space, this assumption gives exactly the value as calculated above for the heat produced in the whole space. I will not here examine whether this is merely a convenient mathematical relation, or if especial physical representations can be connected with this simple regularity. Still we must notice the peculiar connection of this representation with the hypothesis of Kohlrausch on conveyance of heat by electricity. For the present, certainly this connection must be pronounced somewhat superficial, as we have here to do with electrolytic conduction and with uniform temperatures.

If no current passes through the solution ($\mathrm{J}\,\nu = 0$) and there consequently occurs only simple diffusion, the heat produced in any part of the solution is equal to R times the number of the ions which have entered. On the diffusion of an electrolyte from a solution into a more dilute solution the latter will be heated and the former cooled just as it occurs on the issue of a free gas. I do not know of any experiments on this question, but a special case will be discussed below.

Hence, in general, the heat produced in an electrolyte depends on two circumstances :—1, the movement of the electricity ; 2, the movement of the matter. The movement of the electricity occasions heat as it passes from higher to lower potential values. The movement of the matter produces heat, as every ion carries with it the quantity of heat, R, so that an accumulation of ions in a space occasions a liberation of heat depending on the number of ions which have arrived.

(*To be continued.*)

THEATRE LIGHTING IN MAGDEBURG.

IN the report of the management of the gas and waterworks of Magdeburg for 1888-89, some interesting details are given regarding the working of the electric light installation in the town theatre and also concerning the life of incandescent lamps. The installation was in operation for 240 evening and 7 day performances, and in addition a small amount of current was generated each day for lighting purposes from 7 a.m. until the evening performance began. Two 40 H.P. gas engines and one of 5 H.P. were employed to drive the dynamos, and during the whole period of working there was no interruption in the service. At the end of the year there were installed 160 32-C.P. lamps, 356 of 25 C.P., 444 of 16 C.P. and 75 of 10 C.P., or a total of 1,035. Of these 1,028 were placed in the theatre and 7 in the generating house, whilst in the wardrobe room were 5 hair burning apparatus, each taking 2 ampères. Altogether 286 glow lamps had to be renewed.

The incandescent lamps were dusted daily and defective ones replaced by new and tested lamps. At the beginning of the season in September last the corona suspended from the roof of the auditorium was fitted throughout with new glow lamps and the old ones were used under and behind the stage. Tests were made with 40 Edison incandescent lamps supplied by the General Electric Company, of Berlin, in order to ascertain their duration efficiency. The results obtained showed that five of the lamps were unservicable, burning only 66, 433, 483, 515 and 595 hours respectively. The remaining 35 lamps lasted from 518 to 643 hours. The total expenditure during the year was £916, but of this sum the manager of the theatre paid an indemnity of £504. The total cost of the installation was £4,475, or at the rate of £4 12s. 3d. per lamp installed.

LIGHTING OF THE EASTERN RAILWAY STATION IN PARIS.

AN important electric light installation has been completed at the Eastern Railway Station in Paris. The three-wire system of distribution is employed both for the incandescent and arc lamps. The machinery comprises a set of Belleville boilers, and three groups of Weyher and Richemond engines and Sautter-Lemonnier dynamos. Two of these groups supply the necessary current, whilst the third is kept in reserve. The dynamos are series wound, of the two-pole type, and have a capacity of 100 H.P. each whilst running at 300 revolutions. There are in daily use 130 arc lamps requiring 860 ampères, and 1,500 glow lamps taking 1,180 ampères. At this rate of consumption the dynamos are not worked at their full output, and including the third group, the total reserve plant amounts to 20 per cent. The ground surface occupied by the machinery is very limited, but there is still sufficient space to contain a further group of generating machinery. This would enable the actual lighting to be increased by about 50 per cent. The switchboard has been so arranged that one dynamo can easily be replaced by another without any variation in the E.M.F. taking place in the circuit at the moment when the one machine is withdrawn and the other started. An arrangement has been adopted whereby the working of the dynamos may, if desired, be changed from the three-wire to the two-wire system. A noteworthy feature in this installation is, that the railway company's engineers obtained the whole of the plant from French firms, possibly in view of the agitation of the Paris electricians against the employment of foreign machinery in the central stations in that city. The arc lamps used in this installation are of the Cance, Bardon and Henrion types.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 376.)

VIII.—ARMATURE REACTIONS (*continued*).

IN a previous article we considered at some length the nature of the distortion produced in the field by the current flowing in the armature. If the armature carries a current at all, it must produce distortion, that is to say, it becomes a magnet, the cross field of which exercises an appreciable effect upon the original forward field. If the ampère-turns on the armature are few the distortion is correspondingly small and only a small amount of lead is required to bring the brushes into their proper position. But in modern machines the interference of the armature field on the magnet field is considerable, and it is a point of some importance to determine to what extent armatures of given dimensions can be loaded without overstepping the limit fixed by satisfactory working.

It has been shown that if the armature is too powerful the machine becomes unworkable, any attempt to make it run resulting in violent sparking, which very soon ruins the collector and brushes. Now, one of the conditions essential to the successful working of a machine is, that there shall be no sparking, and obviously the ampère-turns on the armature must not be great enough to cause sparking should the normal load be temporarily increased. Machines are not expected to be capable of running continuously at an output of say 20 per cent. above their normal, for the heat generated in working might then produce a greater rise of temperature than would be considered safe or desirable; but in view of the fact that machines while running continuously are often giving an output considerably under their normal, a temporary increase of 20 per cent. should not be attended with any detrimental results as regards sparking, or with any difficulty in collecting the increased current. In determining amount of the radiating surface necessary for a specified rise in temperature, the assumption that the output exceeds the normal is not made, or at least the margin allowed is but small, since the increased generation of heat during the time the machine is overloaded may be considered as compensated by the diminished heat generated during the time it is underloaded. Again, the rising of the temperature is a slow process, a medium size machine taking from four to six hours to attain its maximum. It will thus be seen that the ultimate temperature of a machine in continuous running may be the same with a varying load as with a constant one, and that while there is no reason to provide as regards cooling surface for any *temporary* excess in the output, it is very necessary to allow an ample margin for this as regards sparking. It would be an evidence of bad design if a 20 per cent. increase in the load made a machine spark.

Above is presented one side of the question. The ampère turns on the armature must not be sufficiently numerous to introduce sparking difficulties, but neither must they be too few if economical design is aimed at. Roughly speaking, the armature of a dynamo costs one-third of the whole machine, and for a given cross section the output increases with the ampere turns on it. Of course the copper in the winding increases in the same ratio, so, also, does the copper in the series field coils if the machine is compounded. The ampère turns which can be carried by an armature for a given size of field is limited only by the sparking which occurs when they get too numerous, and economy in design indicates that it is desirable to put on as many ampère turns as we can without overstepping this limit.

Reverting to fig. 145, it will be seen that the cross circuit under each pole piece is very short, and that the cross lines in their paths have to leap the air gap twice. Since the part of the circuit through iron is small, we may say, roughly, that the whole of the magnetising force of the cross circuit is expended in the air gap, and increasing this would diminish almost in inverse ratio the cross induction. In actual machines there are not of course a set of forward lines and a set of cross lines crossing each other, but we have resulting from the superposition of fields a twisted forward induction something like that shown in fig. 147, the tendency of the armature winding to produce a cross field being manifested in the distortion produced in the forward field. The magnetic effect of the armature winding may be resolved into two components, as described in last article, one at right angles to a line joining the pole crowns (fig. 148) which produces a backward induction weakening the field, the other producing a cross induction which twists the field. The relative magnitudes of these two components depend on the position of the brushes. To counteract the effect of the former it is necessary to provide additional excitement on the magnets, while the induction due to the latter, if the machine is to work satisfactorily, must not exceed a certain fraction of the forward induction.

It must be remembered that a lead has to be given to the brushes solely on account of the distortion. In the very act of moving the brushes forward we create a component which weakens the field, reducing at the same time the component causing the cross field. Though we may be unable to determine with accuracy the exact position at which the brushes have to be placed, and therefore the exact value of the component which produces the distortion, we have been furnished by practice with the limiting value for the ampère-turns on the armature for sparkless working, the initial distortion, the lead and the resultant distortion alike depending on the relative strengths of the magnet and armature fields.

(*To be continued.*)

THE MEXICAN TELEGRAPH COMPANY AND THE CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY.

WE take from the pages of the New York *Electrical Engineer* of April 16th, the following statement as to the financial position of the above-named companies :—

"The Central and South American Telegraph Company has just paid (April 8th) a dividend of 1¾ per cent. The Mexican Telegraph Company has declared a dividend of 2½ per cent., payable April 15th, to stock of April 8th. President James A. Scrymser, of the Mexican company, says, the encouraging receipts of the present quarter (to March 31st, 1890) tend to confirm the estimate that the business of 1890 will pay the usual 10 per cent. dividend on the new capital, $2,000,000, and leave a surplus equal to that of 1889. There are now in the treasury 874 shares of the company's stock and 1,634 shares of the Central and South American Company.

"The balance sheet of the Mexican Telegraph Company, December 31st, 1889, shows :—

Assets.

Cost of plant	$1,434,420
Duplicate cable, equipment, &c.	395,034
Cash in Bank	38,245
Bonds, at cost	26,806
Stock, at cost	127,450
Treasury stock, at par	65,600
Open accounts	111,099
Total	$2,198,659

Liabilities.

Capital stock	$1,500,000
Invested revenue	110,913
Premium on treasury stock	16,560
Loan to Central and South American Tele. Co. ...	40,000
Open accounts	95,962
Net revenue to December 31st, 1889	435,223
Total	$2,198,659

"Mr. Scrymser says of the Central and South American Company that this quarter's receipts justify expectation of 7 per cent. on the increased capital of $4,808,000 and as large a surplus as that of 1889. There are now in the treasury 1,920 shares of capital stock. The repair steamer, *Relay*, has been accepted from the contractors.

"The balance sheet of the Central and South American Telegraph Company of December 31st, 1889, shows :—

Assets.

Cost of plant	$4,351,603
Improvements	131,040
Cash in bank	230,833
Bills receivable	11,284
Investment securities	57,861
Temporary loan	40,000
Treasury stock	993,400
Open accounts	256,088
Total	$6,072,109

Liabilities.

Capital stock	$5,000,000
Invested revenue	476,043
Open accounts	11,538
Net revenue to December 31st, 1889	584,528
Total	$6,072,109"

REVIEWS.

Electrical Influence Machines. By JOHN GRAY, B.Sc. London: Whittaker & Co., 2, White Hart Street, Paternoster Row.

In this book we have a full account of the Historical Development and Modern Forms of Influence Machines, together with instructions for making the latter. The work is divided into three parts, the first giving a "General sketch of the phenomena and leading principles of Static Electricity;" II. "Description of Influence Machines;" III. "Practical Construction of Influence Machines." Under the general heading we find that Electrometers are included; also, for no particular reason, we suppose, except that the writer worked under Sir W. Thomson, we have a couple of pages devoted to a brief description of Thomson's potential (or volt) meter. The descriptions of the various types of machines in Part II. are very concise and clear, and are well illustrated. The practical part (Part III.), where instructions are given for the manufacture of a Wimshurst machine, is carefully written, is pretty full, and would enable an amateur to turn out a fairly workmanlike piece of apparatus. The instructions in some cases are, however, hardly sufficiently descriptive, and others, the manufacture of shellac varnish, for example, can only be characterised as "much ado about nothing." Altogether, however, Mr. Gray has done well in bringing out the publication.

Leçons sur L'Electricité professées a l'Institut Electro-Technique Montefiore annexé a l'Université de Liége. Par ERIC GERARD. Tome 1: Théorie de l'Electricité et du Magnetisme.—Electrométrie.—Théorie et Construction des Generateurs, et des Transformateurs électriques. Paris: Gauthier-Villars et Fils, 55, Quai des Grands-Augustins. Liége: Leon de Thier, 12, Boulevard de la Sauvenière.

The first portion of this book consists of an elementary examination of the theory of potential, which serves as a foundation for the study of electric and magnetic action. The chapters which follow are an *exposé* of magnetism and of electrostatics, based on Faraday's researches, and also on the work of Clerk Maxwell and Hertz. The pages relating to electro-dynamics, to electro-magnetism, and to induction, give a simple explanation of the fundamental laws which govern those phenomena. Numerous examples help to make the theoretical formulæ clear. Accumulators and transformers are dealt with concisely, and there are also fairly full descriptions, both practical and theoretical, of different types of dynamos. Although there is a fair amount of original matter in the work, there is (as is the case in most modern works of the kind) a vast amount which is old, and which is practically only redished up; at the same time we think that the work is well adapted for the purpose for which it was written, and is by no means to be despised.

EDINBURGH EXHIBITION.

THE International Exhibition of Electrical Engineering, General Inventions and Industries, was opened yesterday, with all due ceremony, by the Duke of Edinburgh, accompanied by the Duchess, in the presence of a distinguished assembly of English and Scottish nobility and notables. The proceedings commenced, on the arrival of the Royal party in the Grand Hall, by the singing of the National Anthem by the Edinburgh Choral Union, accompanied by the organ and the band of the Edinburgh Orchestral Society. An address of welcome was then read, to which His Royal Highness suitably replied, after which prayer was offered and a psalm sung, which had been specially composed for the occasion. The Exhibition was then declared open, and the proceedings closed with the Hallelujah Chorus. These ceremonial engagements over, the Royal party was conducted round the Exhibition by the officials of the Executive Council. The tour commenced with the Foreign Courts, and continued through the British Section, the Sculpture Galleries, the Machinery Hall and the Locomotives' Court. Arrived at the western door carriages were in waiting to take the party for a drive through the grounds prior to departure from the Exhibition enclosure. The weather was splendid; the city was in holiday array, and the Exhibition, altogether, was inaugurated under very favourable auspices. The completeness of the arrangements, and the forward state of the exhibits, reflect great credit on the Executive Committee, and especially on the manager, Mr. S. Lee Bapty.

On the previous evening a large party of Press representatives were afforded a preliminary inspection of the exhibits, when the electric lighting of the building and grounds was fully tested, and appeared to be complete in every detail. Some alterations have been made in the scheme of lighting as at first intended, of which details will be given in our next.

NOTES.

Aberdeen and Electric Light. — Much interest attaches to a scheme which is being promoted by the Gas Committee of Aberdeen Town Council, for the utilisation of the water in the Loch of Skene for the production of the electric light, and it has been remitted to Mr. Smith, the gasworks' superintendent, to report on the possibility of the Town Council obtaining the surplus supply of water from the dam at Culter Paper Mills for the purpose in view. This dam is supplied directly from the loch. In the event of an arrangement being made whereby the council can depend on a supply of water from this source, it is designed to convey it in pipes from Culter to Justice Mills, at the west end of Aberdeen, where a turbine wheel could be erected to drive a dynamo. It is believed that a sufficient amount and fall of water could be obtained to produce the electricity required to supply the restricted area to be scheduled at the outset.

The Lighting of Chelmsford.—The *Gas World* says Messrs. Crompton must have lost a good deal already by way of fines, for since the commencement not a night has passed without some of the lamps collapsing.

Electric Light at Folkestone.—At a meeting of the Folkestone Town Council, held on Monday evening, some further correspondence was read from the solicitors of Messrs. Crompton & Co., who, a few months ago, obtained the contract for lighting the town by electricity. The letter stated that Messrs. Crompton learned with regret that the Council had refused to grant them an extension of time before producing the light. The date had been fixed for the 1st of July, the date upon which the contract with the Folkestone Gas Company expires, but the letter went on to say that it would be quite impossible to get the plant in working order by that time, and unless an extension were granted they would decline to carry out the contract at all. This gave rise to much discussion, which resulted in the contract being extended to the 1st of January, 1891. At the same meeting the proposal to light the town by oil was again brought forward. The Town Clerk stated that he had written to the Elham Highway Board and ascertained that a Mr. Snested undertook to supply oil, chimneys and wick at Cheriton, and to keep the lamps cleaned and alight for 12s. 7½d. per lamp for three months. A letter was also read from a firm in Dorsetshire offering to supply the Corporation with oil lamps at 35s. each and guarantee them to burn 12 hours per night at the nominal cost of half-penny per lamp. This matter was deferred. We do not envy Messrs. Crompton in their position, as ten members of the Corporation, including three gas shareholders, are against the electric light, the vote only having been carried by a bare majority of one.

Electric Light for Business Premises.—Messrs. E. Jones & Co., Limited, drapers, &c., of Southampton, opened an extension of their business premises named Queen's Buildings, last Thursday. The new suite of shops is lighted by electricity.

Before His Time.—M. Firmin Leclerc, editor of the *Journal des Applications Electriques et Electrotechniques*, mentions the arch-terrorist, Marat, as having warmly advocated the treatment of disease by static electricity.

The "Young Man from the Country."—Says the *Electrical Review*, N.Y., *apropos* of the recent fast speed telegraphic tournament:—"The 'raw-boned youth from the country' has again become famous. He came up from 'daown Hartford way,' and calmly raked in the first prize."

Colonel Gouraud.—Mr. Edison's English representative has arrived in England bringing with him several novelties from Mr. Edison's laboratory.

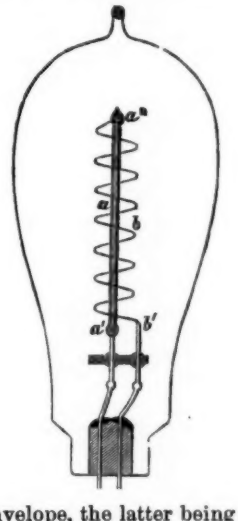
National Telephone Company Please Note.—Mr. J. Lewis Young, general manager of Edison's Phonograph Company, has invented a new telephone mouthpiece, by which it is said the slightest whisper may be heard over any distance of wire. The secret of the invention is in the proportions in which the transmitting tube is made, and as the whole device can be manufactured for a few pence, Mr. Lewis Young proposes to make a free distribution of the mouthpiece to all telephone users in London.

The National Telephone Electrical Society.—This society met on Friday evening, the 18th ult., to hear a paper by Mr. Percy F. Currall on "Batteries," in which the merits of the various forms of cells in the market was discussed. Mr. W. Johnston, on the 25th ult., also read a paper on the subject of "Galvanometers," which gave rise to a lively discussion as to the merits of the D'Arsonval-Deprez as compared with other forms of reflecting galvanometers; this was the last meeting of the session, and there was a large attendance and much enthusiasm. Mr. Arthur E. Cotterell, the vice-president, occupied the chair.

French Exhibition.—It is very likely this exhibition, to be held at Earl's Court, will prove a great success. The list of exhibits is decidedly good, and many will doubtless pay it a visit during the coming summer.

Patent Refused.—We notice that the Commissioner of the United States Patent Office has refused to grant a patent for the application of the Faure secondary battery to the propulsion of vehicles. The refusal was grounded on the opinion that the application of the Faure secondary battery as a propelling power for vehicles was an obvious use, and that the public have the right to employ a given invention in all its obvious uses when the patent has expired; nor may the public be lawfully debarred from the usage of such patent by any subsequent patents seeking to monopolise uses which, while special, are at the same time admitted by experts as pertaining to the original patent.

A New Incandescent Lamp.—Langhan & Co., of Berlin, have just patented a new lamp (*v.* fig.), the principal feature of which is the vertical prop, *a*, supporting the incandescent spiral, *b*. This prop is connected at a^1 with one of the two electrodes, and at a^2 with the spiral which joins the other electrode at b^1. It consists



of a core and envelope, the latter being formed of two metals or alloys, whose coefficient of expansion differs. The heat caused by radiation occasions a difference in expansion between the core and envelope and the internal tensions, the result being the suppression of all lateral flexion.

The Paris Universal Exhibition, 1889.—The report of the Executive Council of the British Section of this exhibition has recently been issued. The guarantee fund raised amounted to £16,800, but it was found unnecessary to make any call upon the guarantors. The chief source of revenue was the money received for space, which was at the rate of 5s. per square foot. It was throughout the object of the Committee to expend the funds entrusted to them by the exhibitors to the benefit of those who provided them, and not to make a considerable margin of profit. The total number of exhibitors in the British Section was 1,149. Throughout the exhibition the average of awards was 50 per cent.; in the British Section it was 90 per cent.

Woodhouse and Rawson, Limited.—The *Financial Times* says: "In answer to repeated enquiries by a shareholder, the secretary of Woodhouse & Rawson, Limited, in a letter dated 22nd inst., states that 'a general meeting will probably be called in May, at which a preliminary statement of the accounts and a report will be presented.' Most shareholders will be of opinion that sufficient time has elapsed to entitle them to expect something more satisfactory than a mere preliminary statement of accounts."

The Institution of Electrical Engineers Students' Meeting.—The students of the Institution met last Friday at the Sanctuary, when Mr. Ernesto Cirla read a paper entitled, "Lightning Conductors according to Modern Theories." Mr. Sydney Sharp took the chair. In the discussion which followed, the Chairman, Messrs. Barton, Wightman, Bone, Parsons, and Müller took part. Mr. Cirla having replied, the Chairman proposed a vote of thanks to him for his interesting paper, which was unanimously carried. Mr. Barton then proposed a vote of thanks to the chairman, which was also carried. At the next meeting, to be held May 9th, Mr. Müller will read a paper on "House Telephones."

Chatham Lighting.—The committee appointed by the Chatham Board of Health to consider the application of the Chatham, Rochester, and District Electric Lighting Company for the substitution of 42 for 21 years as the period at which the authorities could, under the provisional order, purchase the undertaking, have come to a conclusion which is in every way satisfactory, the company's request being acceded to, provided the Board of Trade will agree to the alteration.

A Public Boon.—The French postal and telegraph authorities are busy studying the adaptation to 'busses and tramcars, of both Paris and its suburbs, of portable letter-boxes, in which the public will be able to deposit telegrams, letters and cards. This system has been working satisfactorily for years in Brussels and other places. Could not the same scheme be adopted with advantage here?

Yankee Notions.—"Faire Grand" is not sufficient for Yankee imagination. "Faire plus grand" is more appropriate to our time of exhibitions and other wonders. It is announced that Mr. Eiffel, in concert with Mr. Edison, has offered the Direction of the United States Universal Exhibition to construct a tower similar to that of Paris, but 500 feet higher, the said tower to be illuminated by means of one million coloured electric glow lamps. What next?

The International Telegraphic Congress. — This meeting is to be opened in Paris the 15th May; 130 invitations have been sent, and 90 already answered, 37 of which are from foreign Power representatives. Three great receptions will take place at the Ministry of Commerce to celebrate the event, and visits to the Versailles and Compiègne palaces are being organised. Mr. J. C. Lamb, Mr. H. C. Fischer, and Mr. P. Benton will represent England, and also the Cape Colony and Natal.

Cardiff Electric Light Supply.—The Brush Electrical Engineering Company, Limited, has issued the following circular to their Cardiff patrons:—"We regret to have to inform you that in consequence of the rules of the Board of Trade in regard to overhead wires, and of the decision of the Corporation of Cardiff not to consent at present to our application for a provisional order enabling us to place our conductors underground, we shall have no alternative but to close our lighting station. While thanking you for your past patronage, we must ask you to be so good as to make other arrangements for the lighting of your establishment at your earliest convenience. Next year we shall renew our application for a provisional order, and trust then to obtain the consent of the Corporation, when we shall be prepared to carry out the electric lighting of Cardiff on an extensive and thoroughly satisfactory scale by means of underground mains."

Electrical Roulette.—This is one of the latest applications of science to recreation.

Union is Strength.—The gas company and seven electric light concerns at Cincinnati are reported to have combined their interests.

Central London Electric Railway.—The case for the promoters of the scheme was closed on Friday before the Parliamentary Committee. Sir John Fowler spoke generally as to its chief features, and disclaimed the idea that it would be attended by any engineering difficulty or danger. Sir Benjamin Baker said that there was a practical instance of the working of a similar line in the case of the Southwark Subway, and the success of the proposed system was not a mere matter of experiment, it was a matter of absolute certainty. Originally several of the gas and water companies had objected; but they were now satisfied, and had withdrawn their opposition. It was proposed to light the tunnel by electricity and not by gas, and with regard to what had been said about interference with the sewers, the railway could be shifted to suit the sewers, instead of the sewers being shifted to suit the railway.

On Monday, when the meetings of the Committee were resumed, the case on behalf of the opponents was opened by Mr. Littler. He contended that the proposal was altogether unprecedented; no similar line had ever been worked, and he thought it advisable to wait and see the result of the working of the City and Southwark Subway, before commencing the proposed line through such thoroughfares as it was proposed to build it. Electricity had not been used to work a railway similar to the one before the Committee, because, as he would be able to show them, it was not workable. He appeared for the Paddington estate, which was valued at £8,000,000, with a considerable frontage on the proposed line. This would, he contended, deteriorate if the railway was made. He contended that the omnibus was sufficient to carry the traffic from the West End to the City, and questioned the statement made that the trains would be run at a speed of 15 miles an hour; the greatest speed on any line in America was 12 miles. Evidence was then given in support of Mr. Littler's statement. Further witnesses who opposed the scheme were examined.

Storage Batteries in America.—In view of recent decisions which practically give to Charles F. Brush the control of the storage battery in this country, and of the current report that the Julien Electric Traction Company has become possessed of all his rights by virtue of an arrangement made with Mr. Brush prior to the rendering of the decision of the Court, the question naturally arises, says *Practical Electricity*, what will become of the other storage batteries which are on the market? While there can be no possible doubt of the justice of Mr. Brush's claims, and of the injustice which has so long made it possible for others to appropriate them to their own benefit, in some cases innocently, perhaps, and with no intention to infringe the rights of another, yet it seems a pity that at this late day there should arise any tendency of a monopoly in this business. The perfect storage battery has not yet been obtained, and it will not soon be reached if from this time onward the many inventors who have been working in the field at heavy cost are at once ordered to cease their investigations and experiments. If, now, there should be created any monopoly in the storage battery industry, at this late day in its history, we verily believe that its future will be far from prosperous. Before the storage battery can come into general use there will have to be effected a radical revolution in its construction and a notable diminution of its cost. These changes cannot be brought about by one inventor or by one organisation of capital. The wretched ignorance and mismanagement which have so long prevailed in the Patent Office of the United States, coupled with the ambiguous laws and regulations which are worse than none at all, are solely responsible for this dilemma.

The Royal Society.—On Thursday the following paper was read:—Dr. Hopkinson, F.R.S., "Magnetic Properties of Alloys of Nickel and Iron."

City Commission of Sewers.—A special meeting was held on Tuesday last to consider applications to the Board of Trade for provisional orders for lighting the City by electricity by the London Electric Supply Corporation, the Metropolitan Electric Supply Company, the Brush Electrical Engineering Company, and the Laing, Wharton and Down Construction Syndicate. The Court resolved to oppose the applications of the London and Metropolitan Companies, but to agree with the other two on the condition that the applications were limited in the case of the Brush to the central district of the City, and of the Laing to the eastern district, in respect of which the companies and the Commission had already made contracts. They also decided that the London Electric Supply Corporation and the Metropolitan Electric Light Company should be asked to tender for the supply of the western district on the same terms. The Streets Committee also brought up a report relative to the recent inspection of the electric lighting system at Taunton, and submitted a statement from Mr. Preece, F.R.S., the electrician, thereon, which was ordered to be printed.

The Institution of Electrical Engineers.—On Thursday, May 8th, 1890, there will be the discussion "On a Lightning Guard for Telegraph Purposes, and on the Protection of Cables from Lightning," by Dr. Oliver Lodge, F.R.S., member; "The Treatment, Regulation, and Control of Electric Light by the Legislature and the Board of Trade," by Major P. Cardew, R.E., member.

Reprisals. — Since the Western Union and Postal Telegraph Companies have raised the rates on the Chicago Board of Trade the members threaten to build a commercial line of their own, which shall connect all the principal cities.

Bar Steam.—A new railway, to be operated by cable, electric, pneumatic or other mechanical power (except steam), is the City and Suburban Railway Company, of the district of Columbia, Washington, U.S.A., with a capital of $1,000,000.

Personal.—Mr. Emil Huber, son of the President of the famous Oerlikon Works near Zurich, and himself a prominent engineer and electrician, is visiting America, with headquarters at the New York Electric Club.

Lieut. Bradley A. Fiske, U.S. Navy, has been appointed to Cramps's Navy Yard, as superintendent of the electric plants being installed in the new warships there.

The "Schiséophone."—THE "Compagnie des Chemins de fer du Nord," under the genial direction of the late M. Lartigue, found a place for many electrical appliances, which were extensively used at a time when few people had even thought of turning a sympathetic ear to inventors of electrical novelties. The object of this electro-mechanical appliance, to which we have referred in a previous number, is to detect flaws and internal defects in rails, faults to which the rupture of rails and consequent accidents are mainly due. It is composed of a microphone and a telephone combined with a mechanical hammer or "knocker," and an induction balance, and by its action allows of any internal defects in the materials to be accurately localised. During a number of experiences conducted before some of the high officials of the Northern Railway Company of France and a navy engineer delegated by the Naval Ministry, all the indications of the instrument proved absolutely correct, the rails, &c., on being broken, showing flaws at the exact spot indicated by the "Schiséophone." It is intended to use the instrument for the verification of propeller's shafts, but even if the reports of the usefulness of the apparatus are true, the process seems to us to be one which necessitates much time.

The Faure Electric Accumulator Company.—In the action by this company against Philippart, judgment was given for the plaintiffs in February, 1888. The defendant appealed, and on March 20th, 1889, was ordered to give security for costs to the amount of £30. The security not having been given, Mr. Grosvenor Woods applied on Wednesday last week to the Appeal Court that the appeal might be dismissed with costs. The defendant did not appear, and the order was made accordingly.

Telephone Poles at Southampton.—Owing to complaints from owners and occupiers of adjacent property respecting the unsightly appearance of the telephone poles in the Southampton public parks, the matter came before the Council at its last meeting. The borough surveyor repudiated the assertion that he had ever given his permission for the erection of the existing wooden poles, and said that he saw no reason why iron standards should not be used. It was eventually decided that the telephone company having failed to comply with the terms of the agreement, the Council called upon them to remove the wooden poles and replace them by iron poles to be approved by the surveyor and public lands committee.

The Cost of Lighting an Imperial Train.—We gather from the *Annales Télégraphiques* that, according to M. Verchovsky, the cost of the electric light installation on the Russian Imperial train is as follows:—

	Francs.
Boiler, engine and dynamo	22,025.0
Conducting wires	18,789.5
Signalling and testing apparatus	1,895.0
Commutators and cut-outs	2,221.25
Accumulators	9,900.5
Candelabra, brackets, lights and lamps	10,432.5
Transport, labour, testing, &c.	7,057.5
Total	72,321.25

The Language of the People.—Prof. Cyrus F. Brackett, in his opening address at the Lenox Lyceum Exhibition, New York, made use of the following expression: "Sound is not air; it is air in motion. Electricity is not matter; it is matter doing something. And we are all trying to find out just what it is doing." A New York exchange wishes there were more such men as the Professor, who can fitly express technical ideas in the language of the people.

The Telephone in Canada.—The Bell Telephone Company of Canada has concluded a contract for the construction of a double copper telephone line between the Dominion and provincial capitals. The lines will run over Montreal, and when completed conversation can be carried on between the three points named, a total distance of 280 miles, the longest distance telephone yet attempted in Canada. The cost is estimated at $35,000.

The Prospects of Horses.—The *Electrical Review* N.Y., prophesies that in another few years there will not be a horse car in active service in any of the cities of the United States. It is estimated that anywhere from 20,000 to 50,000 horses now in use will be thrown upon the market. The advance of electricity will, the *Review* adds, have a beneficial effect, in that it will create a demand for higher grade horses at better prices.

The Respite of Kemmler.—The criminal, Kemmler, who has obtained a world-wide notoriety as the first on the list to be electrically executed, is, after all, to be respited.

An Electric Light Manager Tried for Manslaughter.—At New York, on Tuesday, the manager of the Brush Electric Light Company, Mr. Chas. Pierce, was acquited on a charge of manslaughter, the fall of an electric light wire, which caused the death of a man, being held accidental.

Prizes.—La Société d'Encouragement pour l'Industrie Nationale offers various prizes for 1891, among which the following will interest electricians:—£120 for the means of transmitting power long distances; £80 for a small domestic motor, working independently, or from a central station; £80 for the industrial preparation of ozone; £160 for a useful application of metals not hitherto much used industrially; £160 for a publication useful to chemical or metallurgical industries, and £120 for a substitute for gutta-percha in its various applications. The last named is not to be decided till 1893.

Electricity in the Royal Navy.—Some experiments took place a few evenings since at Plymouth with an electric signalling lamp, invented by Commander Scott, of H.M.S. *Excellent*, gunnery ship at Portsmouth. Admiral Sir Wm. Dowell, K.C.B., Commander-in-Chief, watched the trial, which was of a thoroughly satisfactory character.

Electric Lighting at Brighton.—A Local Government Board enquiry was opened at Brighton on Tuesday, respecting an application by the Corporation to borrow £32,500 for the purposes of electric lighting and £4,500 for the purchase of land for a storeyard. Various witnesses were examined, and the enquiry was adjourned.

Dangers of Electricity.—On Tuesday an *employé* of the Electric Light Company of New York, while engaged in removing some disused wires, was seriously injured by the shock from one of the wires through which the current was passing.

Electrical Distribution.—The article "On Current Distribution in Networks of Electrical Conductors," by Messrs. Herzog and Stark, which is concluded in this issue, will, we imagine, be found somewhat difficult to understand with any degree of clearness. The article was written in the authors' English, but it would have been preferable, if we had had the opportunity, of making a translation from the writers' native tongue; this would have rendered the paper somewhat more intelligible. The references to figures, also, in the text, do not always agree with the lettering on the drawings.

Litharge.—In answer to a correspondent, this yellow oxide of lead can be procured in most shops where red lead is sold.

NEW COMPANY REGISTERED.

J. A. Egestorff and Company, Limited.—Capital, £10,000 in £5 shares. Objects: To take over the business of manufacturing ultramarine, colours, &c., carried on by Messrs. Egestorff and Son at Backbarrow, near Ulverston. To carry on the business of electrical engineers and undertakers of the supply of electricity for lighting and other purposes. Signatories (with 1 share each): J. A. Egestorff, J. C. Egerstorff, F. O. Fell, C. B. Daniell, A. H. Thorn, J. Atkinson, all of Ulverston and neighbourhood; S. E. Major, Barrow-on-Furness. Mr. J. A. Egestorff is appointed managing director at a salary of £400 per annum. Registered 24th ult. by Messrs. Waterlow and Sons, Limited, London Wall.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Edison Gower-Bell Telephone Company, Limited.—The annual return of this company, made up to the 14th ult., was filed on the 23rd ult. The nominal capital is £500,000 in £1 shares. The number of shares taken up is 385,009, and of these 370,000 are credited as fully paid up. Upon 15,009 shares the full amount has been called. The calls paid amount to £15,005, and unpaid to £4.

London Electric Supply Corporation, Limited.—The annual return, made up to the 14th April, was filed on the 22nd ult. The nominal capital is £1,250,000, divided into 200,000 ordinary and 50,000 preference shares of £5 each, the whole of which are taken up. Upon the ordinary shares the full amount has been called, and £2 per share upon the preference shares. The calls paid amount to £654,690, and unpaid to £310.

Brush Electrical Engineering Company, Limited.—An agreement of 29th January (filed February 1st) provides for the purchase by this company from the Australasian Electric Light, Power and Storage Company, Limited, certain patent and also shares in that company to the nominal value of £18,000. The purchase consideration is £23,500, payable by the allotment of 4,700 fully paid preference shares of £2 each, and 4,700 fully paid £3 ordinary shares.

The statutory return of this company, made up to the 9th December, was filed on the 24th ult. The nominal capital is £750,000, divided into 150,000 ordinary shares of £3 each, and 150,000 preference 6 per cent. shares of £2 each. The shares taken up are 63,416 ordinary and 63,416 preference, the whole of which are fully paid, the paid up capital thus being £317,080.

Foreign and Colonial Electric Power Storage Company, Limited.—An agreement of 22nd November, filed 25th ult., provides for the purchase from the Electric Construction Corporation, Limited, certain licence and patent rights for the sum of £75,000 in cash. This agreement is ratified by an agreement of 5th December, also filed on the 25th ult.

An agreement of 24th February, filed on the 25th ult., varies the former agreement, and provides for the payment of the consideration of £75,000 in ordinary fully paid shares, or partly in cash and partly in fully paid shares, at the option of this company. An agreement of 21st ult., filed on the 25th ult., provides for the allotment of 15,000 fully paid ordinary shares of £5 each.

Macmahon's Patent Electric Check System, Limited.—An agreement of 31st March, filed 25th ult., provides for the purchase by the company of certain patents referred to in an agreement of 6th March, the consideration being 1,000 fully paid shares of £10 each.

Electric Meter Company, Limited.—An agreement of 17th ult., filed 25th ult., provides for the purchase by this company, from the Corporate Trust, Limited, of the scientific experimental business carried on by Sir H. C. Mance, at 355, City Road, under the supervision of Theodor Wittkugel, and certain patents in connection therewith. The purchase consideration is £20,000 in fully paid ordinary shares. Registered office, 25, College Hill, E.C.

Patent Lithographic Zinc Plate Company, Limited.—The registered office of this company is at India Chambers, Queen's Dock Side, Hull.

Tilbury Portland Cement Company, Limited (concrete and metal telegraph and signal poles). The registered office is at 105, Leadenhall Street, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

THE developments of the House-to-House Company, cannot fail to be of great interest to those concerned in the progress of electric lighting in England. Advocating a system about which little controversy exists as to the utility and safety, we do not see how it can fail to prove a valuable concern in the future. There is vast energy in the management as shown by a numerous off-

spring; although many may not reach maturity there will certainly grow up a creditable and respected family. The success of the Brompton company is assured when one considers the class of present and probable consumers. The accounts show a loss for the three months ending December of £23, which is a much better result than most new companies show after working so short a period. Of course, it is presumed that at the meeting the chairman will give a few particulars of the working since January, and seeing that since that period several large installations have been completed, it should not be a matter of difficulty.

THE chairman of the Indo-European Telegraph Company made some rather significant remarks as to the falling off in the revenue account. Since 1886, the year of the reduction of tariff, there has been a steady decrease in revenue account. The matter must be dealt with very shortly in the interests of the shareholders. The fact is quite plain that, as in the case of the reduced American tariff, there is not a sufficient demand for a cheap tariff to recoup the company, and as the telegraphs are used mainly by a profit-seeking community who chiefly adopt codes, we imagine the directors must follow in the track of the American Cable companies and increase the price per message.

The House-to-House Electric Light Supply Company, Limited.

THE directors' report and accounts for presentation at the second ordinary general meeting, to be held at Kensington, on the 5th May, 1890, at 4 p.m., states that the total number of shares issued is 8,322 ordinary shares of £5 each, and 100 founders' shares of £5; and, in order to meet the further requirements of the company, the directors have issued £30,000 debentures, convertible into ordinary shares, which will provide plant at the Kensington station, capable of supplying houses wired for over 25,000 lamps, consuming 33 watts.

Parliamentary powers, under the Electric Lighting Acts, 1882—1888, giving the company 42 years' tenure in a wealthy residential district at Kensington have been granted to the company.

The district contains 12,854 private houses, 2,250 shops, 39 churches and chapels, 105 hotels and public houses, 14 public buildings, including board schools, of the gross rateable value of £941,371.

Since these powers have been granted, and the supply mains laid, there has been a steady increase in the company's business. The company's mains now extend throughout seven miles of the principal streets of the area allotted to the company by Parliament, reaching the extreme end of the eastern and southern boundaries at Sumner Place and the Fulham Road respectively.

Since the 1st October, 1889 (the date the company obtained power to lay supply mains in the public streets), orders for the supply of electricity have been received at the rate of about 400 lights per week, making at present a total of over 12,000 lights.

The number of lights at present connected to the company's mains is about 7,000, and the revenue from these lights already covers the whole of the working expenses and the depreciation and establishment charges; so that a considerable profit will accrue, when the extension of the lighting is brought up to the full power of the plant, as no further capital expenditure will be required, and the cost of producing the current will be relatively much reduced.

The net revenue from the station (including the additional unit of plant for which capital has been provided) when in full work, is calculated at £8,000 per annum, after allowing £7,000 per annum for working expenses, depreciation, &c.

Many private consumers are now taking electric current, the list being too long for publication.

The central electric lighting station at Kensington is generally admitted to be the most perfectly equipped central electricity supply station that has yet been erected. The machinery is divided into three units of plant, each capable of producing electricity for 3,000 33-watt incandescent lamps burning at one time. The station is designed for 12 of such sets of plant, with a capacity for supplying about 100,000 lamps, installed in about 2,000 houses, and it is the directors' intention to issue further capital from time to time to provide for laying down the additional units as the business of the company extends.

The excellence of the engineering work done by the company in planning and laying down the Kensington station is so generally recognised, that the directors are continually receiving enquiries from supply companies and local authorities throughout the United Kingdom, with a view to their contracting for laying down similar electric lighting stations elsewhere.

Eleven provincial companies have been registered, in which this company holds the whole of the founders' shares, entitled to half the profits after 7 per cent. has been paid on the respective capitals.

The company holds a portion also of the founders' shares in the three following companies:—The Devon and Cornwall Electricity Supply Company, Limited; the Portsmouth and South Hants Electricity Supply Company, Limited; the Sunderland and District Electricity Supply Company, Limited.

The provincial companies are applying for provisional orders in their respective districts for the chief towns, including such important places as Manchester, Birmingham, Leeds, Edinburgh, Bristol, Liverpool, Newcastle, York, Glasgow, and many others.

The London company has given notice of intended application for provisional orders in the parishes of Islington and district, Hampstead and a portion of the district of the Willesden Local Board, Fulham, Hammersmith, Acton, Ealing, Wandsworth, Paddington, and Lambeth.

As favourable business arises in connection with these provisional orders further issues of capital will be made.

The increasing favour with which householders are regarding the use of the electric light affords a field for the operations of the company which is practically unlimited, and the moderate capital upon which the company has to pay a dividend bears marked contrast to the capital of other companies seeking for similar business. Moreover, this company has an immense advantage in being able to show a sample of its work in successful operation, and in having at its command the services of engineers who have been connected with house-to-house electric lighting from central stations from the beginning.

The retiring directors are Mr. Henry Ramié Beeton and Mr. Robert Hammond, who, being eligible, offer themselves for re-election.

The auditors, Messrs. Theobald Bros. and Miall, also retire, and offer themselves for re-election.

The profit and loss account for Kensington central station shows: installations account—materials and wages, £5,231 4s. 8d.; office expenses, £280 14s. 10d.; generating and distributing electricity—working expenses, wages, coal, oil, &c., October 1st to December 31st, 1889, £555 9s. 1d.; ground-rent, October 1st to December 31st, 1889, £43 15s.; rates, October 1st to December 31st, 1889, £29 3s. 4d., in all amounting to £6,140 6s. 11d. By installations (wiring new premises) (£4,832 7s. 7d.), and ditto (work in progress) (£610 7s. 5d.), £5,442 15s.; consumers' accounts for electricity, October 1st to December 31st, 1889, £480 14s.; transfer fees, £7 12s. 6d.; discount and interest, less interest on debentures, £185 16s. 2d.; balance (loss), £23 9s. 3d.; total, £6,140 6s. 11d.

Indo-European Telegraph Company.

THE ordinary general meeting of the above company was held at Winchester House, on Monday last, Mr. Herbert J. Tritton in the chair.

The Chairman in moving the adoption of the report and accounts, of which an abstract appeared in the REVIEW on April 12th, said, he would draw the attention of the proprietors to the work of the company for the past year. The results of the working they had already seen in the report, which were the same as the previous year. The receipts were less by the sum of £2,038. Expenditure on commercial accounts had been practically the same, with variations in the details, but coming to maintenance account, the expenditure had been materially more, and showed an increase to the considerable sum of £6,819. This, they would be pleased to hear, was attributable solely to additions and improvements in the lines. In view of this expenditure they carried forward, as the shareholders would doubtless remember, from 1888 to 1889 a sum of £6,783, and, if he remembered rightly, they told them that that would in all probability be absorbed. The forecast made by Mr. Andrews was singularly accurate, for the additional expenditure during the year was almost precisely that amount. The year current was one in which they would have to face an extraordinary expenditure of maintenance account, but not of the same serious nature. The amount depended very much upon the amount of work which they put through the lines during the year, it was impossible to say how much, but he thought, without fear of events belieing his words, that it was not likely to affect any dividend which might be earned. They were still face to face with the fact of the decreased revenue from messages exchanged with India mentioned last year. The cause of this had followed upon the reduction of the tariff which took effect in July, 1886; since then the receipts from this source had shown a continuous decline of a serious character. He would put before them statistics of the gross receipts of Indian messages for the last five years:—In 1885 the amount was £394,270; in 1886 (the year when the reduction of tariff was made), £374,122; in 1887, £342,272; in 1888, £334,129; in 1889, £328,490. He did not think he was wrong in saying that the decrease was of a most serious nature. The result was the more extraordinary because the imports and exports of India had not shown the same unsatisfactory decrease. The Chairman then read from the *Journal of the Chamber of Commerce* reports showing increased imports and exports. They were driven to look for an explanation elsewhere than in the trade itself. These contradictory results showed two or three things—first, that decreased cost did not stimulate the demand in the case of long distance telegrams; secondly, that the systematised use of code, and possibly that of registered addresses, had attained greater proportions; and thirdly, that the average of all the items which make the external trade of India, so far as had been effected by telegrams, must have been larger. He thought it was a matter on which they had not yet touched bottom. It was a subject which would be considered by the International Conference. Private messages, in plain language, did not affect their business; it might be difficult to believe, but it was a fact that under ordinary circumstances private messages did not amount to 1½ per cent. of the business passing over the lines. They would see, therefore, how deeply they were interested in the coding and "packing" systems of the present day; but their busi-

ness was to cultivate friendly relations with their merchant friends, who of course acted within their rights. In conclusion, he referred to the good work performed by the staff under the guidance of Mr. Andrews. The resolution was then formally moved.

Major-General Tremenheere seconded the motion.

The Chairman, in reply to Mr. Jackson (a shareholder), said that Mr. Jackson had made a forcible appeal to the directors to consider the subject of dealing with the reserve fund within a period not so remote as the period of the termination of the concession. This matter had been considered by the board from time to time, who were in favour of a good reserve fund. Of course there might be differences of opinion among the shareholders as to receiving back a portion of the reserve fund in return on capital. He would not go farther than to say at present that the subject would receive attention.

The motion was then put to the meeting and carried unanimously.

Mr. C. Holland and H. H. Meier, the retiring directors, were re-elected, as also the auditors of the company.

A vote of thanks to the Chairman concluded the meeting.

The China and Japan Telephone Company, Limited.

THE ordinary general meeting of this company was held at 14, Austin Friars, yesterday, Mr. Lloyd (in the absence of Mr. Erichsen), in the chair.

The report for the year ending December, 1889, stated the revenue account, after charging debenture interest and writing off a sum of £190 15s. 10d. in respect of depreciation of plant, &c., shows a balance of £741 to credit, which has been transferred to profit and loss account.

Including the sum of £32 16s. 4d. brought forward from last year, this account shows an amount of £773 16s. 4d. to credit, which the directors propose to carry forward after writing off £200 in final extinction of preliminary expenses account.

At both Shanghai and Hong-Kong the increase of revenue during the year has been fairly satisfactory, and the exchange at the latter place is now nearly self-supporting.

As foreshadowed in a previous report, the competition in sales of material has increased, resulting in a diminution of profit from this source.

In order to provide additional working capital, the directors have issued during the present year a further £500 of debentures, bearing interest at 7 per cent. These were taken up by the Oriental Telephone Company, Limited.

The chairman said that business was fairly progressing, as shown by the report; they were carrying forward a large balance to write off depreciation. He therefore moved that the report be adopted, which was seconded by Mr. Grewing.

Mr. Little (a shareholder) said that they had not received a dividend for eight years, and it occurred to him it would be better to have the capital at a figure which would enable them to pay a dividend. He hoped the directors would consider the matter.

The Chairman said they could not say anything definitely at the meeting, but the matter would be considered.

The report was then adopted. Mr. Hy. Grëwing was re-elected director, and the company's auditors were re-elected.

Submarine Cables Trust.

THE trustees' report to be presented at the nineteenth ordinary annual meeting of the certificate holders, to be held at the offices of the Trust, No. 50, Old Broad Street, London, on the 7th day of May, 1890, states that

The accounts for the financial year, to 15th April, 1890, are submitted herewith. The revenue for this period, including the balance of £165 1s. 6d. brought from the previous accounts, amounted to £23,259 6s. 10d.

The coupon due on 15th October, 1888, was paid in two instalments, viz., £2 12s. 6d. on 15th April, 1889, and the balance of 7s. 6d. on 15th May last. The first payment of £2 12s. 6d. was included in the previous year's accounts, but the balance of 7s. 6d. was a charge against the revenue for the past year.

The expenses of the Trust amounted to £1,274 0s. 5d., and the payments on account of the coupons to £21,553 17s. 6d., together £22,827 17s. 11d., leaving a balance of £431 8s. 11d. to be carried forward.

In addition to paying the 7s. 6d. outstanding on the October, 1888, coupons, the coupons due on April 15th and October 15th, 1889, have been met in full out of the revenue for the past year. The certificate holders have thus received interest at the rate of 6¾ per cent. in the past year as against 5¾ in the previous year. The coupons due on April 15th, 1890, are in arrear, and will be paid as soon as the trustees have sufficient money in hand for the purpose.

The trustees regret the loss sustained in October last by the death of Sir Daniel Gooch, Bart., who was connected with the Trust since its formation. The trustees do not recommend that the vacancy thus occasioned in their number be filled up, the remaining trustees being quite competent to manage the Trust. An appreciable saving in the expenses will thereby be effected.

A table showing the original and present investments of the Trust is appended to this report.

The meeting will have to elect two auditors for the current year; Mr. John G. Griffiths and Mr. John Gane offer themselves for re-election.

The Telephone Company of Ireland.

ON Saturday last the eleventh ordinary general meeting of the proprietors of this company was held at their offices, Commercial Buildings, Alderman Dillon, chairman of the company, presiding.

The secretary read the directors' report for the year 1889, from which the following is an extract:—

"The number of wires, exchange and private, under rental on December 31st, 1889, was 1,309. On December 31st, 1888, the number was 970, being an increase of 339 for the year. This increase has been caused principally by the opening of exchanges in Cork and Limerick, the number of subscribers to the exchange system in Cork having risen from 24 at the opening of the exchange on January 1st, 1889, to 295 on December 31st, 1889. As additional capital is required for the extension of the business of the company, and for the establishment of the proposed through trunk line connection between the telephone exchanges of Dublin and Belfast, the directors offered to the shareholders 10,000 new 5 per cent. preference shares in proportion to their respective holdings. The subscriptions to these new shares have not been sufficient for the purposes required, and as the directors consider that the improved position and increasing revenue of the company should enable them to raise the necessary funds at an interest not exceeding 5 per cent., they are unwilling to issue the shares as heretofore, as 6 per cent. shares. They therefore propose to submit a resolution to enable them to issue debentures to an amount not exceeding in the aggregate the unissued balance of the authorised issue of 75,000 preference shares."

The Chairman moved that the report be adopted, and that a dividend at the rate of £1 2s. 6d. per cent. per annum on the ordinary share capital of the company for the year ended the 31st December, 1889, be declared, and that the interim dividend paid last August of 1 per cent. per annum for the half-year ended 30th June last be confirmed. That was the first occasion on which he had to meet the shareholders in that position, although he had been with them in another position since the inauguration of the company. It was a source of deep regret to him that he should occupy that position in succession to two very warm friends of his —one of them one of his greatest friends, the late Mr. Gray, the first chairman of the company, with whom, as solicitor, he had the honour to be associated in introducing the telephone system in Ireland. They regretted also the death of Alderman Winstanley, who addressed them as chairman at the last meeting of the company. The company were now to be congratulated on their progress. Since they last met an exchange had been opened in Cork, and the results there had been extremely satisfactory. From having at the commencement of the year 1889 24 subscribers to the Cork exchange, they had on the last day of the year 295 subscribers. Their position in Cork had been somewhat peculiar. The Government or Post Office department had the control of the telephone service in Cork up to this year. That company entered into competition with them during the year, with the result, he was glad to say, that the Government were practically beaten out of the field; and the company had now the control of the telephone service in Cork, with subscribers to the number of nearly 300, although the Government, in the year that they had it, reached only a maximum of 30 subscribers. Belfast was out of their control. It was now worked by the company with which they were associated, the National Telephone Company; but they had made arrangements with that company for the construction of a trunk line between Dublin and Belfast, and they hoped the work would very speedily be in hand. Their development of the system in Cork had led to the result that their earnings could not be taken as representing what their future earnings for their speculation would be, because they had not yet reached the advantages which would accrue to them from their expenditure in Cork. But their earnings generally had increased considerably during the past year, and now they had to divide a net earning of £8,900, as against £7,870 in the previous year. Their expenditure both in Cork and in another direction had been considerable. In Dublin they had replaced within the year, at a very large expense, nearly all the old iron wires, which, at the time they were laid, were considered the proper kind, by new copper wires, the life of which was very much longer indeed than that of the old iron wires. To meet their increased expenditure, but principally for the development of the trunk line to Belfast, they issued to their shareholders additional preference capital. They tried the experiment of issuing it at 5 per cent. to their preference shareholders. He was afraid that they rather spoiled them by issuing the shares previously at 6 per cent. The result was that their shareholders did not appreciate, as they thought they ought to have done, the investment at 5 per cent., and did not take sufficient of the shares. They were, therefore, obliged to issue them now in the shape of debentures. On this subject a special resolution would be proposed. The report also dealt with a formal matter, namely, their relations with the National Telephone Company, in consequence of which some alterations in their articles of association had become necessary. He had to apologise for the non-attendance of some of the directors, with whom that happened to be a specially busy time, and who were, therefore, obliged to be absent.

Mr. Arthur Dudgeon seconded the motion, which was unanimously agreed to.

The Chairman moved the following resolution:—

"Resolved—That the directors be and they are hereby authorised to borrow any sum or sums of money on such security and terms, as to interest or otherwise, as they may deem fit, and may

secure the same by mortgage or by other debentures, or by bonds, or by any mortgage or charge of or upon the whole or any part of any property, funds, assets, or effects of the company, including uncalled capital, but so that not more than £25,000 be owing at any time, and that not more than £10,000 be issued without the previous consent of a general meeting."

Mr. Arthur Dudgeon seconded the above, which was unanimously carried.

The retiring directors, Alderman V. B. Dillon and Mr. Hermann G. Erichsen, were re-elected.

Mr. M'Kean was appointed auditor.

A vote of thanks was given to the chairman, which having been passed, the proceedings terminated.

Oriental Telephone Company, Limited.

THE ordinary general meeting of this company was held at Cannon Street Hotel, on Tuesday last, Mr. Addison presiding.

After the secretary had read the notice convening the meeting,

The Chairman, after referring to the report which appeared in these columns last week, said he was glad to say the company was making steady progress and had greatly strengthened its financial position. In 1884 the reserve fund, which had for the previous two years stood at £7,000, was, in order to meet the exigencies of the financial situation at that time, transferred to the credit of the profit and loss, and since then, until last year, no reserve fund had existed. The directors had, however, felt that as soon as they were in a position to do so a new reserve fund should be formed, so that in case of need there would be a fund to fall back upon other than the uncalled capital of the company. In pursuance of that purpose £225 had been placed to the reserve fund last year, and this year they added £2,000, which must add to the strength of the company. The reserve fund now stood at £4,400 against £7,000 in the beginning of 1884. It was easily available and could be used on emergency. They had written off £500 for depreciation of stores at branches. They had decided to have at the bank a certain sum of money on deposit, so that they might benefit from the interest. Referring to a change at Mauritius, he considered it was a very good one, and likely to lead to business. They had endeavoured to come to terms with the holdersof the vendors shares so that they might have only one class of share, but they had not yet succeeded. He hoped they would receive some definite terms before long from those holders. He begged to move the adoption of the report and accounts.

The resolution was carried unanimously. Mr. Addison, who retired, was re-elected chairman and Mr. Frost director.

The company's auditors being re-elected, a vote of thanks to the chairman terminated the meeting.

The West India and Panama Telegraph Company, Limited.

THE directors' report and accounts for the half-year ended 31st December, 1889, to be submitted to the 26th ordinary general meeting to be held on 7th May, 1890, shows the amount to credit of revenue £42,768 0s. 1d. (against £43,061 16s. 9d. for the corresponding half-year of 1888), and the expenses £27,071 7s. (against £21,425 1s. 2d. for the same period in 1888), leaving a balance of £15,696 13s. 1d., which, with the balance of £1,609 2s. 1d. brought from last account, makes a total of £17,305 15s. 2d., with which it is proposed to deal as follows: First preference shares, dividend, six months to 31st December, 1889, 6s. per share, £10,368 18s.; second preference shares, on account of arrears of dividend to 31st December, 1889, 27s. 6d. per share, £6,419 17s. 6d.; balance to current half-year's account, £516 19s. 8d., making a total of £17,305 15s. 2d.

The traffic receipts for the six months show a decrease of £594 12s. 7d., as compared with the corresponding period of 1888.

The large increase of £5,718 15s. 1d. in the cost of repairing cables is accounted for by the number of interruptions having been in excess of the average, and by the expenditure of greater lengths of new cable to renew and strengthen the system in those parts where weakness or decay were proved to exist.

In a previous report, the shareholders were informed that a new line of cables connecting Santiago-de-Cuba (our terminal station), with Hayti, San Domingo, Curacao and Venezuela, had been laid and opened for traffic by a French company, and at the three last half-yearly meetings the chairman has referred to the possible extension of the French company's operations within this company's system. The directors have now to report that the French Government, in furtherance of its policy to encourage independent telegraphic enterprise by its own subjects, has entered into a convention with this new company for connecting Martinique and Guadeloupe, with a view to an eventual extension to the United States and Europe by a French line of cables, and that in pursuance of this convention, a cable (about 100 miles in length), was laid between Martinique and Guadeloupe and opened for traffic in February last, thus competing with this company's cables between those islands. At the instance of the French Colonial Minister the annual subsidy of £2,000 hitherto paid by Martinique to this company is held to be withdrawn by the Council General of that island, and a like subsidy has been granted to the competing company, notwithstanding that such subsidy was previously renewed to this company up to the 31st December, 1890. To this manifestly unjust proceeding the directors will offer such objections as they may be advised are open to them.

Martinique and Guadeloupe are, however, still dependent on this company's duplicated cables, comprising some 4,000 miles, for their telegraphic communications with the rest of the world, and for their daily bulletins of news and market prices which cost this company a large sum to collect and transmit, although the subsidy is transferred to an undertaking performing none of these obligations, and connecting these two colonies by an isolated length of only 100 miles of single cable.

In accordance with the articles of association, Sir James Anderson and William Andrews, Esq., retire at the meeting and offer themselves for re-election.

John George Griffiths, Esq., the auditor, also retires, and offers himself for re-election.

The Brazilian Submarine Telegraph Company, Limited.

THE directors' report and accounts for the half year ended December 31st, 1889, to be submitted to the thirty-third ordinary general meeting to be held on May 7th, 1890, states that the revenue for this period amounted to £121,119 5s. 11d., and the working expenses to £15,201 14s. 2d. After providing £12,880 for debenture interest and sinking funds, and £1,671 14s. 10d. for income tax, there remains a balance of £91,365 16s. 11d.; to this is added £2,609 3s. 9d. brought forward from June 30th last, making a total of £93,975 0s. 8d. First and second interim dividends amounting to £39,000 have been paid and £45,000 transferred to the reserve fund, leaving the sum of £9,975 0s. 8d. to be carried to the next account.

In accordance with the provisions for repayment of the first issue of debentures, dated July 31st, 1884, 153 bonds representing £15,300 were drawn on the 25th instant, for payment at par on July 31st next. This, with the previous drawings, will make a total repayment of £80,800, leaving £69,200 of the first issue of debentures outstanding.

The working expenses of the stations are £1,630 in excess of those for the previous half year; the increased expenditure is principally due to the extension of the company's staff quarters at St. Vincent, the furnishing thereof and the augmented staff rendered necessary by the South African traffic exchanged at St. Vincent with the cables laid to the Cape of Good Hope.

The various sections of the company's line are in good working order.

Brighton Electric Light Company.

THE annual general meeting of the Brighton and Hove Electric Light Company was held at the company's offices, on Friday evening last. In the absence of Mr. Robert Hammond, the chairman of the company, Mr. Latham was voted to the chair.

In referring to the report and balance sheet for the last year, which appeared in the REVIEW on April 11th, the Chairman very much regretted that the company was unable to declare a dividend, but said it would be found that the accounts were far from being unsatisfactory, and the company might congratulate themselves upon the steady increase of their business, which, but for reasons stated in the report, would have yielded a dividend as great, or even greater, than that declared in past years. After detailing the reasons for the state of affairs, he felt that the Corporation had treated the company most unfairly, but their experience assured them that it would be impossible to supply electricity at the present time for less than 10d. per unit unless the supply was much larger than can be expected at present, leaving out the fact that the company was working the most economical system known. This was proved beyond all doubt by the experience of Chelmsford, where one of the Brighton Corporation's electrical advisers, Mr. Crompton, definitely said that he cannot supply at less than 1s. 4d. per unit, and this on the low tension system adopted by the Brighton Corporation. The company had again applied to the Board of Trade for a provisional order, and trusted that notwithstanding the fact that the Brighton Corporation had hitherto refused to consider any advances towards compromise on their part, some arrangement would ultimately be made. The Chairman concluded by proposing that the report and accounts for the year ended December 31st, 1889, be received and adopted.

Swan United Electric Light Company, Limited.—The directors have decided to pay an *ad interim* dividend of 6 per cent. for the six months ending 31st March, 1890.

London Platino Brazilian Telegraph Company.—A meeting of this company was held at the offices of the company yesterday, but our representative was refused admission.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 25th, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,652.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (April 24.)	Closing Quotation. (April 30).	Business done during week ending May 1, 1890.	
					Highest.	Lowest.
£						
250,000	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	98 —101	98 —101		
1,549,160	Anglo-American Telegraph, Limited	Stock	49 — 50 xd	50 — 51	51	49⅜
2,725,420	Do. do. 6 p. c. Preferred	Stock	83½— 84 xd	85 — 86	86½	83¼
2,725,420	Do. do. Deferred	Stock	14½— 14⅝	15⅛— 16	15⅝	14⅜
24,000	Australasian Electric Light, &c., Limited, Nos. 1 to 24,000 ...	5	... ...	... ...		
130,000	Brazilian Submarine Telegraph, Limited	10	12½— 12⅝	12½— 12⅝	12 9/16	12¼
99,000	Do. do. 5 p. c. Bonds...	100	101 —103	101 —103		
75,000	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	105 —108	105 —108		
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ...	3	2¼— 2⅜	2¼— 2⅜	2⅜	2⅛
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1⅝— 1¾	1⅝— 1¾	1¾	1⅝
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	9/16— 11/16	9/16— 11/16	11/16	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5⅛— 5⅜	5⅛— 5⅜		
16,000	Cuba Telegraph, Limited	10	11 — 11½	11 — 11½	11½	...
6,000	Do. do. 10 p. c. Preference	10	17½— 18½	17½— 18½		
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3¾— 4¼	3¾— 4¼		
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10		
60,710	Direct United States Cable, Limited, 1877	20	10½— 10¾xd	10½— 10⅝	10 5/16	...
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅛— 14⅜xd	14⅛— 14⅜	14 7/16	14⅜
70,000	Do. 6 p. c. Preference	10	14¾— 15¼xd	14⅝— 15¼	15	14¾
200,000	Do. 5 p. c. Debs. (1877 issue), repay. Aug., 1899	100	106 —109	106 —109		
1,200,000	Do. 4 p. c. Mortgage Debenture Stock	Stock	109 —111	106 —108	110	107½
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	14⅛— 14⅜	14⅛— 14⅜	14⅜	14 5/16
320,000	Do. 6 p. c. Debentures, repay. February, 1891	100	100 —102	100 —102		
446,100	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. ...	100	103 —106	103 —106		
12,500	Do. 5 p. c. Debentures, 1890, redeem. ann. drawings ...	100	100 —102	100 —102		
367,900	Eastern and South African Tel., Ltd., 5 p. c. Mort. Deb., 1900...	100	102 —105	102 —105	102½	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4⅜— 5⅛	4⅜— 5⅛	5⅛	5⅛
46,700	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	4⅜— 5⅛xd	5⅛— 5⅜	5⅜	5⅛
19,700	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£3 only paid)	5	2⅛— 2⅜	2⅛— 2⅜		
180,227	Globe Telegraph and Trust, Limited	10	8⅜— 9⅛xd	8⅞— 9⅛	9 1/16	8⅞
180,042	Do. do. 6 p. c. Preference	10	14⅛— 15⅛xd	14⅞— 15⅛	15	14⅞
150,000	Great Northern Tel. Company of Copenhagen	10	15½— 16	15½— 16 xd	16	15 13/16
40,000	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	102 —105	102 —105		
250,000	Do. do. do. (issue of 1883) ...	100	104 —107	104 —107	104¾	...
9,334	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	12 — 13	12 — 13		
5,334	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11 — 12	11 — 12		
41,600	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	18 — 19	18 — 19	18⅛	18⅛
200,000	Do. do. 4½ p. c. Deb., 1896...	100	103 —105	103 —105		
17,000	Indo-European Telegraph, Limited...	25	40 — 42	38 — 40 xd		
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7		
100,000	Do. do. do. 6 p. c. Debentures ...	100	107 —110	107 —110		
49,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	5⅛— 5⅜	5⅛— 6	6⅛	5 11/16
386,875	National Telephone, Limited, Nos. 1 to 386,875	5	5⅜— 5⅝	5⅞— 6⅛		
49,825	Do. New Nos. 386,876 to 436,700 (£4 only paid)	5	4 — 4⅛	4⅛— 5		
15,000	Do. 6 p. c. Cum. 1st Preference	10	12½— 12⅝	12½— 12⅝		
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	10 — 11	10 — 11		
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	⅛— ¼	⅛— ¼xd		
9,000	Reuter's, Limited	8	7¾— 8⅛	7⅞— 8 xd	7 15/16	...
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	¼— ⅜	¼— ⅜		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3¼ only paid)	5	3¼— 3⅜	3¼— 3⅜		
3,381	Submarine Cables Trust	Cert.	110 —115	110 —115	112	...
78,949	Swan United Electric Light, Limited ... (£3¼ only paid)	5	4⅛— 5	4¼— 4⅜xd	4⅜	...
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45⅜	45
150,000	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 — 104		
55,000	United River Plate Telephone, Limited	5	4⅛— 5	4⅛— 5		
146,000	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94		
100,000	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	9½— 10½	9¼— 10½		
300,000	Do. do. do. 5 p. c. Debentures	100	99 —102	99 —102	100½	...
30,000	West Coast of America Telegraph, Limited	10	9½— 10½	8 — 9	8⅞	...
150,000	Do. do. do. 8 p. c. Debs, repay. 1902 ...	100	121 —126	121 —126	122	...
64,572	Western and Brazilian Telegraph, Limited	15	10½— 11	10¼— 11	10⅞	10⅜
26,986	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 6⅝	6½— 7	6⅞	6¾
26,986	Do. do. do. 5 p. c. Deferred	7½	4½— 4⅝	4¼— 4⅜	4⅜	...
200,000	Do. do. do. 6 p. c. Debentures "A," 1910...	100	106 —109	106 —109		
250,000	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	104 —107		
88,321	West India and Panama Telegraph, Limited	10	2⅞— 3⅛	2⅜— 2⅝	3	2⅝
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11½— 12	11½— 12	12	11⅞
4,669	Do. do. do, 6 p. c. 2nd Preference ...	10	14 — 15	14 — 15	14⅞	14¼
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	122 —126	122 —126		
179,300	Do. do. 6 p. c. Sterling Bonds	100	99 —101	99 —101		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£2 only paid)	5	1½— 2	1½— 2		

Stock Exchange closed May 1st.

* Subject to Founders Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 6¾—7¼.—Electric Construction Corporation (£10 paid), 9¾—10¼.—House-to-House Company (£5 paid), 5—5¼.—London Electric Supply Corporation, Ordinary (£5 paid), 2¾—2⅞.—Manchester Edison and Swan Company, £9, (£1 paid), 11/- —12/-.

BANK RATE OF DISCOUNT.—3 per cent. (17th April, 1890).

THE ALTERNATING TRANSFORMER SYSTEM IN SOUTH AMERICA.

(FROM A CORRESPONDENT.)

THE alternating transformer system which has only of late been introduced into South America finds there continued and very satisfactory extension. This fact is the more significant as the industrial development of the South American States is still in a very primitive stage; and, indeed, South America derives its supplies of industrial articles almost exclusively from Europe. The rapid extension of the transformer system is due in part to the demand for light in civilised tropical regions (which is much more intense than in northern countries), and, in part, to the very high prices of gas in the South American towns. Hence the competition of the electric light is easy and tempting, which induces the erection of extensive electric works. For such installations, at least in large towns, the use of the transformer system is the cheapest and the most convenient, especially as in South America there is no objection to the application of aerial leads on a large scale.

The first application of the transformer system was at Montevideo with two machines, each of 80,000 watts, erected in 1887 by MM. Luis Podesta and Luis Topolansky. After this installation had been set in successful action, its owners succeeded in floating a a large electric company, which was constituted under the title "La Uruguya," and after obtaining a concession for the electric lighting of the city, it erected large works with six machines of the Zipernowsky type, W_6, collectively of the capacity of 480,000 watts, which have been already in successful operation for nearly a year. Certainly the working conditions are still rather South American, as is shown very drastically in the following interesting extract from a letter of the managing engineer. He writes:—

"Spring is now beginning, and the street boys have begun their usual games, slinging, aiming stones at the porcelain insulators on the supports of the leads, kite flying, &c. It is needful to keep a sharp eye on the primary leads. Three men go about all day armed with long poles in order to knock down kite-tails from the leads."

Of still greater interest is the subjoined extract from another report:—

"We must watch lest the lamp-lighters of the gas company, who, from intelligible reasons are the sworn foes of the electric light, do some mischief. There are even in our own staff some men who, from ill-will, seek to play tricks on their fellows. For half the town I have 30 men in this service, as well as some secret inspectors, armed with knives, who look out for the mischief makers. I myself often enough range the streets by night, accompanied by my first official, with loaded revolvers in our pockets. The chiefs of the wire and lamp inspectors are on horseback, as also myself and my chief official, and as soon as any mischief begins we gallop up from all sides."

As an interesting detail in the execution of the electric works at Montevideo, I may mention that the condensing water for this installation is drawn from the sea at a distance of 250 metres. The condensation arrangements have been supplied by Tangye Bros., Limited, of Birmingham.

At Buenos Ayres an installation is in course of erection with two alternating current machines of the type A_8, each for 320,000 watts (consequently a joint capacity of 640,000 watts). The electric machines and transformers, as well as the steam engines, have been already supplied, the former by Ganz & Co., of Buda-Pest, the latter by the Machine Company of Brünn. Both the steam engines (of 600 H.P. each) and the alternating current machines make 125 revolutions per minute, and are in direct connection, so that the magnet wheel of the alternating current machine forms the fly-wheel of the steam engine.

At Mercedes a transformer installation for lighting the town has been erected. An alternating current machine of the type A_7 for 160,000 watts is here in use. It is driven by means of a band by an engine of 300 H.P., supplied by Ruston, Proctor & Co., of Lincoln. A second engine is to be procured by way of reserve.

In Brazil the transformer system is being worked by an electric company at San Paulo. It was founded in 1887 under the style "Marques Monthe y Ca.," and wished to begin with erecting a large transformer installation at San Paulo. But the slender means of the company did not permit the completion of the works which they had commenced. They had to confine themselves to the erection of a small continuous current installation, driven by a locomotive for lighting up a limited district of the town. Last year the company was reorganised with an accession of fresh capital, and the undertaking, thus strengthened, adopted the name Companhia Luz Electrica de San Paulo, and is occupied with the erection of two electric works at San Paulo and Casa Branca.

The installation at San Paulo is for the present equipped with an alternating current machine of the type A_5, of 50,000 watts, and a corresponding number of transformers, the latter enclosed in iron cases and fixed on wooden supports. The motive power is furnished by a Westinghouse engine of 80 H.P.

At Casa Branca there is used an alternating current machine of the type, A_3 (30,000 watts), driven by a "Colonial" steam engine by the firm, Tangye, Limited, of Birmingham. Here, also, the transformers are placed in iron cases on wooden supports.

Both at San Paulo and Casa Branca wood is used as heating material in the installations. In Brazil the competition of the electric light with gas is much facilitated by the high price of gas-coal, whilst wood for fuel can be very cheaply procured from the primitive forests. Insulated aerial leads are used in both cases.

THE ELECTRIC TORCH IN "ASCANIO."

AN interesting application of electricity to theatrical purposes was made in connection with the ballet in *Ascanio*, M. Saint-Saën's new work at the Paris Opera. This was the torch carried by the genii and constructed by M. Trouvé. The torch, which was of very limited dimensions, had to be kept alight for a quarter of an hour each evening. An incandescent lamp was concealed beneath the "jewelled" torch-head and a battery of six accumulators was placed in the staff. The accumulators were of the Planté pattern composed of leaden plates 5 centimetres high and 7 centimetres broad, rolled upon each other.

The total active surface was about a square decimetre per element. Each accumulator had a casing of thin glass enveloped in gutta-percha and measuring 7 centimetres in height and two centimetres in diameter. The batteries were divided in two superposed groups, and the elements were all mounted in series with an intervening space of 1½ millimetres between the plates. The accumulators were capable of holding out for 30 minutes, *i.e.*, two performances. They supplied a 10 volt 3 ampères current during 20 minutes. In lighting the torch, the actress who took the part of Phœbus and carried the genii's torch, applied thumb pressure to a spring situated in the handle, when the connections were formed and the lamp was lighted. The accumulators were daily charged at the electric station attached to the opera.

Insuring Employés.—The Detroit Electric Light and Power Company has adopted a plan of insuring its *employés*, every one of whom carries a $5,000 policy, the premiums upon which are paid by the company so long as he is in its employ. The arrangement insures the *employé's* family in case of accidents, and protects the company from damage suits.

THE ELECTROLYTIC EXTRACTION OF COPPER IN HUNGARY.

[FROM A CORRESPONDENT.]

THE 14th of April, 1890, will be remembered as an epoch in the history of copper mining in Hungary. On this day the first establishment for the production of electrolytic copper in the kingdom was opened, and in future the electro-technical industry in Hungary will draw its supply entirely, or in great part, from native sources. This event is the more significant, as mining in Hungary—a country very rich in metallic ores—has latterly, especially in Upper Hungary, been continuously declining.

This decay of the Upper Hungarian mining industry has its especial reasons. In consequence of the growing production of foreign mines and furnaces, a depression of prices was unavoidable, and only those undertakings could stand against the competition which had some advantage by reason of the character of the ores employed, of cheaper fuel, lower wages, or especially of the utmost possible simplification of the entire process, and which could consequently put their produce on the market at lower prices than others. In the last respect, especially, the scientific progress abroad had placed us at a serious disadvantage. How complicated, tedious and costly is with us, *e.g.*, the extraction of copper, almost the most important of all metallic elements, and especially the refining of black copper. How well has it been understood abroad for years how this process may be simplified by taking advantage of the most recent advances of science, and enlisting electricity in the service of the miner and the metallurgist. Since the first application of electro-metallurgy at the Royal Smelting Works at Ocker, the electrolytic extraction of metals has been successfully carried on in several foreign works. We, however, have been indolent enough to take no notice of all these improvements, and to continue the struggle for existence with inferior appliances to those of our rivals.

At last Herr Alexander Soltz, the director of the smelting works in the Upper Hungarian Waldbürgerschaft, an engineer who had been well trained, both theoretically and practically, turned his attention to the scanty communications which have appeared in journals and treatises on the electric extraction of fine copper, and entered upon the study of the new process with a view of introducing it into the "Stefan" works. This was more easily said than done. At Ocker, whither Soltz first went, an examination of the establishment was refused him, and the other concerns which had introduced the electrolytic process kept the details a complete secret. Thrown back thus upon his own resources, Soltz turned with the greater zeal to the study of this important question, and after spending some years in experimenting, he finally succeeded in solving the difficult problems of the composition of the electrolytes and the strength of current required. The President of the Upper Hungarian Waldbürgerschaft, Arthur Protsner, took up the matter, and, with his experienced eye, recognised the scope of the new invention. For a man of his popularity and influence, it was not difficult to gain over the board of directors of the Waldbürgerschaft for the new process. Thus arose the installation for the electrolytic production of fine copper at the "Stefan" works. It has been in operation since March 12th, but was only formerly opened on April 14th. This is the first installation in which fine copper is produced from argentiferous grey copper ore by the electric current, and silver is separated out. The process leaves nothing to be desired on the score of simplicity.

The electrolytic process for refining black copper is conducted essentially as follows:—Plates of black copper are suspended in an acid bath of sulphate of copper (bluestone). Between every two such plates there is suspended a sheet of pure copper, and the current is passed from the black copper to the pure copper. Thereby sulphate of copper is decomposed in such a manner that the sulphuric acid is liberated on the plate of black copper (the anode), combines there with an equivalent quantity of copper and passes into solution, whilst the copper is deposited in the metallic state on the sheet of pure copper (the cathode). Admixtures of antimony, arsenic, lead and bismuth, as well as the gold and silver present in the black copper, remain as a mud at the bottom of the bath. The composition of the bath is not essentially affected by this process, though in time it becomes poorer in copper. Still, the bath used—as it has been proved by experiments at the "Stefan" works—can remain in use for years, though it must be from time to time restored to its original concentration by the addition of sulphate of copper or of a solution of granulated copper. The black copper is previously submitted to a purifying process in a reverberatory furnace, that it may be freed from iron which would contaminate the liquor. The liquor, which circulates in 49 baths, arranged like stairs in seven ranks, is pumped up by pumps of hard lead out of the two large tanks into the highest baths, and returns then to the tanks, after passing successively through all the baths. It is produced by dissolving granulated copper in hot dilute sulphuric acid, with access of air. The same apparatus is afterwards used for regenerating the liquor.

All the machinery has been made in Hungary. The motor for driving the machines is formed of a Girard's partial turbine, supplied from the Krompach Hernáder Ironworks, of 32 nominal horse-power, of which at present only the half is in use. The same works have supplied the ingenious apparatus for transmission and the iron columns. The current for electrolysis is supplied by a continuous-current dynamo of the type Δ_2, by Ganz & Co. This machine is generally constructed for a strength of 60—70 ampères and 100—110 volts. In this case the wrapping has been so altered that the machine making 700 turns per minute gives a current of 240 ampères and of 24 volts tension. The strength of the current and the tension are shown automatically by an ammeter and a voltmeter. A hand rheostat serves to regulate the current. The current has to pass all the baths in succession, so that the same quantity of copper is dissolved and precipitated, amounting to about 328 kilos daily in full work. In each bath there are eight anodes and seven cathodes, all connected with the conductors. The copper sheets used as cathodes are made at the works by precipitating copper to the thickness of 2·3 mm. upon brightly polished sheets of copper, slightly oiled and insulated at the margin with a coating of asphalt or paraffin. In three months the plates of black copper are nearly consumed, and the cathodes have become plates weighing 70—80 kilos, not fibrous or lumpy, but remarkably clean and pure.

The silver mud at the bottom of the baths, which is about $\frac{1}{10}$th of the weight of the black copper, is pumped up into a filter-press and further treated for the extraction of silver.

As Austria and Hungary have each a common import system it is to be expected that the process adopted at the "Stefan" Works will find ample scope in Austria.

AN ELECTRICAL EXHIBITION IN NEW YORK.

[FROM AN AMERICAN CORRESPONDENT.]

THERE is at present being held in New York, at a large concert auditorium called the Lenox Lyceum, an electrical exhibition embracing various interesting features. The major part of the exhibits consists of an arrangement of historical apparatus illustrating Mr. Edison's various inventions; these are all arranged on stands and in glass cases round the hall. In an adjoining room are placed a number of phonographs, which are kept busy all the evening rattling off music and speeches to patient listeners. The basement, however, contains the greatest attraction of the exhibition, which is visited by a never-ceasing stream of visitors all

through the afternoon and evening. This is the joint exhibit of the American Telephone and Telegraph (long-distance) Company, and the Metropolitan Telephone and Telegraph Company.

It may truly be said that such a wonderful demonstration of the perfection at which telephony has arrived has never before been given or attempted in any part of the world ; and, in fact, were it not for the thoroughly systematic and scientific methods of construction, both as regards apparatus and lines, which the long-distance system has necessitated, and which the long-distance company has organised and perfected, such an exhibition would be impossible even here, in the land of telephony *par excellence*, to-day.

At the entrance to the space allotted to the telephone exhibit are placed five cabinet booths or silence cabinets, each containing a long-distance set of instruments. Visitors are allowed free use of these cabinets to call up and converse with their friends in any part of the country in connection with the company's system, such important towns as Albany, Boston, Buffalo, Providence, Philadelphia, Baltimore, and Washington being among those available for communication. Needless to say, visitors to the exhibition avail themselves very freely of the privilege thus offered, as the charm of chatting easily and comfortably with a friend 250 miles distant is enhanced by the fact that no charge is exacted. Five minutes' conversation with Boston in the regular manner costs four dollars, so that visitors cannot help feeling that the telephone company treat them very handsomely.

The first part of the exhibit proper is a large square room containing a loud-speaking telephone receiver provided with a trumpet attachment to intensify the sound. The transmitter attached to the other end of the line which terminates at this receiver is in Boston ; in front of it sits a gentleman who by turn plays the cornet, makes speeches, gives recitations, and imitates the cries of denizens of the farmyard. When he gets tired he sets the phonograph agoing and lets it spout whatever it has to spout into the mouthpiece of the transmitter. It makes no difference to the listeners, however, whether it is speech or cock-a-doodle-doo, original cornet, or phonographed cornet, every note can be heard perfectly in all parts of the room, and is listened to by all with rapt attention. Although other parts of the exhibit are perhaps more entertaining, this listening to speech and music coming all the way from Boston without even having to hold up a receiver to one's ear is what astonishes visitors more than anything else in the whole building.

In another large room is placed an upright wooden framework draped with red cloth and provided with a shelf about breast high on each side. Wires connected with a regular long-distance switchboard are run all round this framework, to which are connected 200 small receivers with the magnets at right angles to the diaphragm, similar to those used in the police telephone system. These receivers are arranged in five separate groups. Four of these groups contain forty receivers connected in sets of five in multiple, each set of five being connected in series with the next. These four groups are connected through the underground system of the Metropolitan Company with two of the New York theatres where comic operas are being played. The fifth group contains 39 receivers arranged in multiple series of three, and is used for connecting with the long-distance system for the reception of music and speeches from Boston. The arrangement of the receivers was arrived at after a number of experiments, it being found at length that the five in multiple series gave the best results for local transmission, and three in multiple series for long-distance transmission. The transmitters used in the theatres are of special construction, designed for the occasion, with large diaphragms and heavy adjustment of the carbon buttons. A number of these transmitters are placed at intervals on the face of the parapet of the first balcony, this having been found by experiment to be the best position. The secondary coils of all the transmitters are connected to the line wire in multiple arc ; two transmitters are worked from the same battery, the Fuller being the type of cell employed.

This part of the exhibit is crowded every night by a throng of delighted visitors listening to snatches of the "Grand Duchess" and the "Pirates of Penzance." It becomes a matter of no small difficulty to keep the people moving so as to relieve the crush from the rear, as when once visitors get hold of the telephones the sensation of hearing music by wire so plainly is such a fascinating one that it is only when a piece of dialogue intervenes, and hearing becomes difficult, that they are inclined to relinquish them. The other evening I saw a lady hold on to a pair of telephones, all through the long wait between the two acts of the "Pirates," in order to hear the famous policemen's chorus.

Taken as a whole the exhibit is a remarkable and extremely interesting one, and serves a double purpose in drawing a large attendance daily to the Exhibition (which is given in aid of the New York Exchange for Woman's Work), and of familiarising the public with the advantages of telephone communication, both local and long distance.

The installation has been carried out in a remarkably short space of time by the technical staff of the Long Distance Company with some assistance from that of the Metropolitan Company, the whole being under the direction of Mr. F. A. Pickernell, the energetic and talented superintendent of equipment of the Long Distance Company. It is somewhat unfortunate that the newspapers take a very mean advantage of the efforts of the telephone companies to put their best feet forward on this occasion ; nearly all of the newspaper reports comment unkindly on the fact that while the companies can make such a wonderful display at an exhibition yet they continue to give their subscribers the very worst class of telephone service that the subscribers can be induced to put up with. It is only natural that the reporters, in their ignorance of technical matters, should overlook the fact that the entire installation at the Lenox Lyceum is arranged on the long-distance metallic circuit system, and hence the excellent results. The Metropolitan Company is at present spending hundreds of thousands of dollars in putting down metallic circuit underground cables, and in fitting up new exchanges with improved switching apparatus, and in the course of a year or so the telephone service in New York will be in a vastly improved condition throughout. Of this I may have something to say in a future letter.

CASUALTIES FROM LIGHTNING IN FRANCE DURING THE YEAR 1888.

FROM the very full and complete tables given in the *Annales Télégraphiques* we extract the following details of accidents due to lightning reported in France during the year 1888 :

Persons.		Animals.		Trees.	Buildings.
Killed.	Injured.	Killed.	Injured.	Struck.	Struck.
6	10	10	2	8	26

TELEGRAPH SYSTEMS.

Wires.		Posts.		Insulators.		Instruments.	
Ruptures.	Totally destroyed. Length, metres.	Struck.	Destroyed.	Struck.	Destroyed.	Struck.	Destroyed.
49	590	647	377	812	468	*790	†300

* Of instruments struck 627 were lightning protectors
† Of instruments destroyed 290 were lightning protectors.

AYRTON AND PERRY'S TWISTED STRIP VOLTMETER.

A paper read by Prof. PERRY at the British Association meeting at Newcastle, 1889.*

AT the Physical Society some years ago I announced that a strip of material, to which a permanent twist had been given, behaved in much the same way as one of our now well-known springs; that is, when it was acted upon by axial forces, there was a relative rotation of the ends; in fact, the twist gets less. As some people have a difficulty in understanding what I mean by a twisted strip, I have prepared fig. 1 to illustrate my meaning. The relative rotation is perhaps better

FIG. 1.

seen in a strip whose permanent twist is right-handed at one end and left-handed at the other. If a pointer be attached to the middle, as shown at A, Q, B, fig. 2, and the ends are pulled out, the pointer rotates. This double twisted strip we have applied to weighing machines, aneroid barometers, and many other instruments, such as wire-testing machines, and I can recommend its use in all cases where a force has to be measured, and where it is not advisable that there should be a considerable amount of yielding. For example, spring balances are sometimes used acting directly on specimens as testing machines; but when the specimen breaks, the recoil of the balance is likely to cause it to get out of order. Again, if a double twisted strip is used as a tension piece in a jointed structure, a pointer set at its middle will indicate the pull at any time.

The only likely suppositions I could make in thinking of what occurs in a twisted strip were, 1st, that two spiral filaments symmetrically disposed relatively to the axis resembled the two threads in a bifilar suspension, if a sufficiently short length of strip was considered; 2nd, that the tensile stress was uniform over a cross-section of the strip at right angles to the axis; 3rd, that the resisting couple was due to the torsional rigidity of the section of the strip, still taken as rectangular. These suppositions lead to the result

$$\phi \propto \frac{\mathrm{W}\, l\, n\, b}{t^3},$$

where W is the axial force, l the length of the strip, n the number of complete spires given by permanent set to unit length of the strip, b the breadth of the strip, and t its thickness, ϕ being the small rotation produced by the small load, W.

Now such experiments as I have hitherto made on steel strips point rather to some such law as the following being roughly correct:

$$\phi \propto \frac{\mathrm{W}\, l}{b\, t^3}.$$

That is, the rotation seems to be independent of the amount of twist originally in the strip, and instead of increasing as the breadth of the strip increases, it diminishes. It is evident that the motion is a much more complicated one than I had imagined. Now, I found that if a double-twisted strip was placed in tension and its ends were fixed, the pointer rotated if the temperature was altered, so that its use as a pyrometer or thermometer was possible.

In this instrument before you (figs. 2 and 3), we have a tube, A, H, D, C, B, about two-thirds of whose length, A, H, D, is brass, and about one-third, C, B, is iron. A double-twisted strip of platinum silver is in tension in the axis of the tube, with its ends fastened to the ends of the tube, but one of them electrically insulated from the tube. The tube just at the middle of its

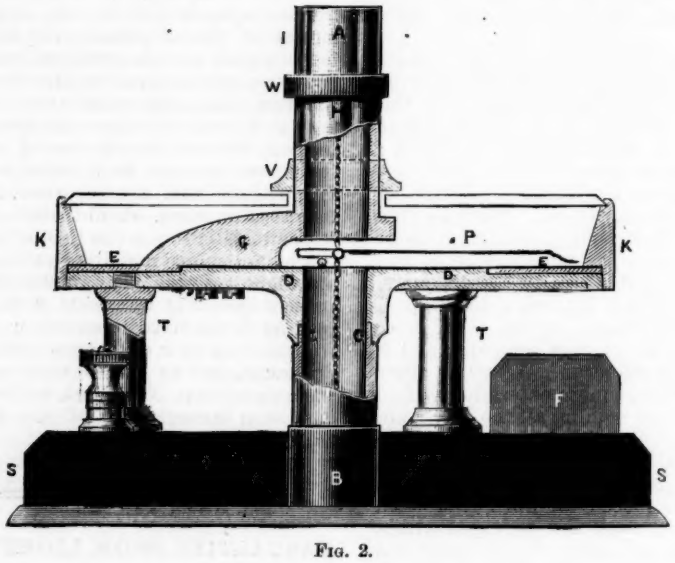


FIG. 2.

length, D, G, becomes a strong thin bracket, which enables a pointer, Q, P, attached to the strip to make a rotation of nearly 360°, and the arrangement of the bezel and dial will readily be understood without any further description. A and B are caps to the ends of the tube; when the cap, A, is turned the initial pull in the strip is altered, and this furnishes a zero adjustment.

When the various parts of this instrument are all at the same temperature the pointer remains in the same position, whatever that temperature may be. When a current is passed through the strip the pointer records the difference of temperature between the strip and its case, and hence the readings on the dial may be made in ampères. Again, the readings may be in volts for the potential difference between the ends of the strip or the terminals of the instrument. These instruments before you read to 2½ volts; they waste almost exactly *one watt* at their highest reading.

By inserting resistance of platinoid or of German silver we can increase the range of the instrument, but of course we expend more energy in such a case.

That there may be no creeping or permanent set or hysteresis, we find it sufficient before graduation of the instrument to keep sending a current greater than the highest which is to be used on the instrument for 72 hours, breaking and making the current once in

* The above paper is given as it was written in September last. When it was written, the author felt certain of the constancy of the fatigued strips. Six months of further experience have since confirmed his views.

every minute. This process is performed by the second's hand of a clock passing into and out of a bath of mercury in every revolution.

It is quite wonderful to observe the complete change in elasticity produced in a strip by this kind of fatigue. The strip seems to undergo no alteration afterwards by mere use or disuse, but it is my intention to test this by many months' experience before allowing these instruments to be manufactured. The two instruments before you are the only two yet made.

I had hoped to be able to show you one in which the strip is of flashed carbon. Here are specimens of twisted carbon strips, but unfortunately they are all too coarse for a 50-volt instrument, which is what I intended them for.

transformer before you transforms in the proportion of 50 volts to 1, so that the instrument may be used on the ordinary 100 or 110 volt circuits. By using a different winding on the transformer the same instrument may be graduated for a 1,000 volt circuit. I find that this transformer maintains the same proportionate transformation of voltage, whether the frequency of alternation of current is 50 or 100 per second.

This pleasing result was not altogether unexpected, but it certainly was unexpected to find that if a sufficient quantity of iron is used in the transformer there is a constant ratio of transformation of current for quite different frequencies of alternation. Hence I find that this 2½ volt instrument may be graduated as an ammeter up to 1,000 ampères or more, or a volt-

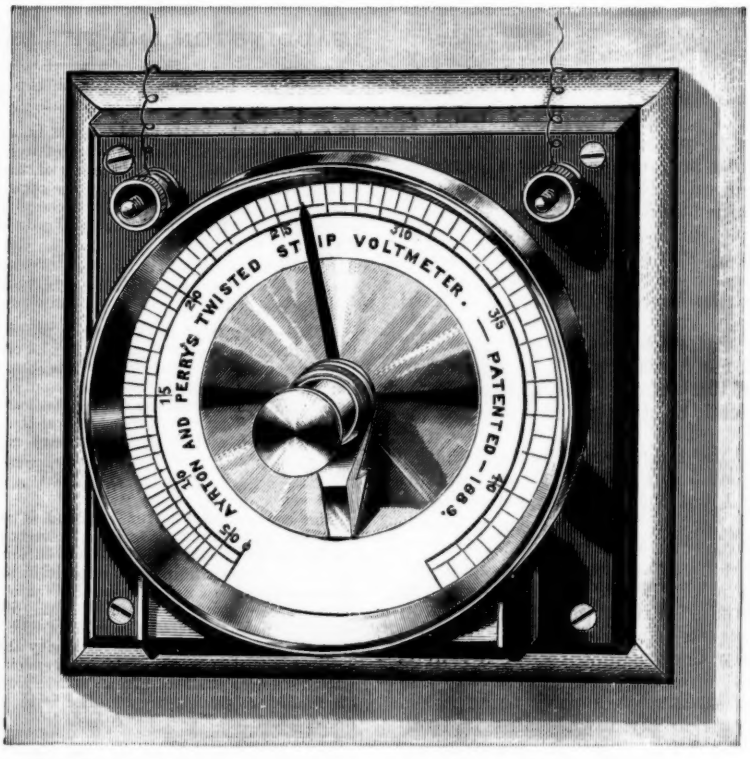


FIG. 3.

For accumulator work the 2½ volt instrument is greatly needed, and I prefer this form to our hot wire instrument, because of its great simplicity and its needing so very little adjustment in manufacture.

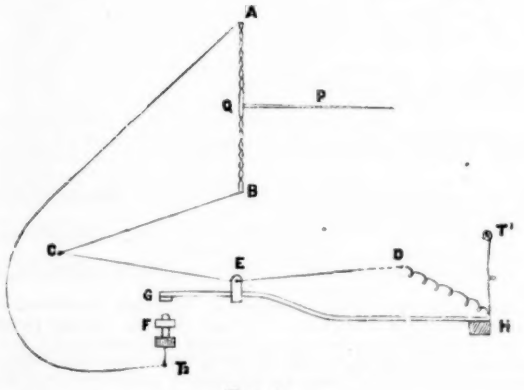


FIG. 4.

For alternating currents this 2½ volt instrument may be used through any range whatever by placing a small transformer on the base of the instrument. The little meter up to 1,000 volts or more, the transformer being the only variable thing about it. I need hardly say that with several transformers and resistance coils at the side of this instrument we may almost call it a universal instrument.

Added later.—Fig. 4 shows our fuse arrangement—T_1 and T_2, are the terminals of the instrument; current flows from T_1, through the short thin copper wire, T_1, H, then through the adjustable resistance coil, H, D, then through the tightened platinum silver wire, D, E, C, whose ends are fixed, and which is kept sagged and tight by the metal spring, H, G; then through the twisted strip, B, A, to the terminal, T_2. But should the voltage between T_1 and T_2 be so great as to be liable to hurt the instrument, the wire, D, E, C, sags so much that the end, G, of the spring short circuits the instrument through G, H, and the thin copper wire, H, T_1, the copper wire being instantly melted.

Bibliography.—A monograph by M. Hippolyte Fontaine, upon the performances of the Syndicat International des Electriciens during the Paris Exhibition of 1889, will shortly appear through Baudry et Cie, the publishers.

LOCAL AUTHORITIES AND ELECTRIC LIGHTING.

A DEPUTATION from a large number of Town Councils and other local authorities attended at the offices of the Board of Trade last week with reference to the model order under the Electric Lighting Acts recently issued by the Board of Trade. The deputation was introduced by Mr. H. S. Wright, M.P., who described the members as thoroughly representative of the great interests involved. The objections of the local authorities to the order had been formulated at a meeting in the Westminster Palace Hotel, and they were placed before the Board of Trade officials *seriatim*.

Mr. GAINE, Town Clerk of Blackburn, pointed out that clause 6 of the order was entirely new, never having appeared in previous orders. It meant if the undertakers of any system of electric lighting were to go outside their area the order they had obtained might be revoked. He maintained that such a provision was entirely unnecessary, because if the undertakers exceeded their powers they would be acting *ultra vires*, and could be dealt with at common law. The clause was one which was not quite fair, though it could be made an advantage rather than a disadvantage by being amended so as to give the Board of Trade power to authorise the laying down of mains in adjoining districts.

Mr. CALCRAFT said the Board of Trade were inclined to agree to that.

Mr. GAINE asked that under clause 8 "ten acres" should be substituted for "five acres," the population and extent of many of the boroughs whose Corporations were applying for electric lighting powers requiring the larger figure.

Mr. CALCRAFT said the Board would agree to that.

Mr. GAINE also objected to the second paragraph of clause 9. He pointed out that the last paragraph of that clause was new. Section 13 of the principal Act authorised, or purported to authorise, the Board of Trade to consent to the breaking up of private streets, railways, and tramways, and if this paragraph were to stand—which prevented electric lighting mains from being laid in private streets—an important power would be taken away. Many Corporations had relied upon the general power of the Board of Trade, and had scheduled no private streets. A second point raised was the refusal of power to lay down mains in roadways, crossing railways, &c.

Mr. CALCRAFT said they would meet the objection as to private streets by amending the clause. Nothing could be done on the second point, which could be met, Mr. Gray thought, under the Gas Works Clauses Act.

Mr. GILL, Town Clerk of Birkenhead, suggested that clause 12, having reference to compensation, should be amended by omitting in sub-clause "A" the words "and stating the amount of compensation, if any, proposed to be made in respect thereof and the manner in which such compensation is proposed to be paid or secured," and by inserting in sub-clause "C" "and the amount of compensation payable to the owners."

This suggestion was accepted by the board.

Mr. SOUTAS (Darlington) stated the objections felt to the clause requiring local authorities to give security, and this it was also agreed to omit.

Mr. CALCRAFT further notified the deputation that clause 18, giving power to revoke an order because of a defect in the construction of works, would not be gone on with, as they were going to put in other clauses which would meet that.

Mr. JOHNSON, Town Clerk of Nottingham, who said he represented a Corporation owning a gas works, objected strongly to the provision which limited the time for the completion of works to two years. Then he objected to the clause which compelled the undertakers to lay down mains when guaranteed 20 per cent. upon the cost of the mains by six persons or more. What they asked was that they be allowed to lay down their conditions in each case, with power for those concerned to refer to the Board of Trade if dissatisfied.

Mr. CALCRAFT said the clause would have to stand, but with a proviso that there would be an appeal to the Board of Trade, which would also cover the question of time.

A discussion then arose as to the appointment of inspector, Mr. JOHNSON and others of the deputation strongly objecting to the power of appointment remaining with the Court of Summary Jurisdiction, and it was agreed that the Board of Trade should make the appointment. Alterations were agreed to in several minor matters to which objections were taken, and the deputation then withdrew.

PADDINGTON AND THE ELECTRIC LIGHT.

LETTER FROM THE BOARD OF TRADE.

IN answer to the letter of Mr. Mark H. Judge (referred to in last week's ELECTRICAL REVIEW), protesting against the chairman's declaration at the special meeting of the Paddington Vestry, as to the resolution to discontinue its opposition to the provisional order of the Metropolitan Electric Supply Company, the following communication from the Board of Trade has been received by Mr. Judge:

"Board of Trade, London, S.W.

"*Electric Lighting Acts*, 1883 *and* 1888.

"Mark Judge, Esq.

"Sir,—With reference to your letter of the 23rd inst., addressed to the President of the Board of Trade, on the subject of a resolution passed by the Vestry of Paddington in regard to the application of the Metropolitan Electric Supply Company, Limited, for a provisional order under the above mentioned Acts, I am directed by the Board of Trade to forward to you the enclosed copy of a letter that they have addressed to the vestry in the matter.

"I am, sir, your obedient servant,

"HENRY G. CALCRAFT."

The copy of the letter enclosed is addressed to the Vestry Clerk by Mr. Calcraft, as assistant-secretary to the Board of Trade, acknowledging receipt of the resolution alleged to have been passed for discontinuing the opposition to the Metropolitan Electric Supply Company's application for a provisional order. The letter concludes as follows:—"I am directed by the Board of Trade to point out that the rules of the Board of Trade require that the consent of the local authority shall be given to an application for a provisional order at a special meeting, of which one month's notice shall be given; and to inform you that the Board of Trade are unable to dispense with this requirement in the present instance."

RAILWAY RATES INQUIRY.

CLASSIFICATION OF TELEGRAPH INSULATORS.

THE question of the classification of telegraph insulators, *packed*, came before Lord BALFOUR of BURLEIGH and Mr. COURTENAY BOYLE, sitting at 8, Richmond Terrace, Whitehall, as a Board of Trade inquiry into railway rates and charges, on Monday last.

Mr. A. TROTTER, on behalf of the electric section of the London Chamber of Commerce, objected to the admission of this item. The objection of the railway companies was that they should be classed with electric insulators in class 2. Electric insulators was a vague term, and he could not say what it meant, but telegraph insulators was a well-known term, and he need not describe them. Telegraph insulators were generally made of earthenware, and were generally sent out with the spikes fastened to them, and formed a rather heavy article. They were in the Railway Clearing House classification in class 1.

Lord BALFOUR of BURLEIGH: Packed, not as you describe it.

Mr. TROTTER: I am alluding to packed.

Lord BALFOUR of BURLEIGH: But your objection does not say so.

Mr. TROTTER: I am surprised at telegraph insulators, not packed, being put down here. I thought they were always packed. I have nothing to say, except on packed insulators, and I do not know whether anyone appears for them unpacked. We object to their being put with insulators, which, as I said, is a very vague term. Electric insulators are commonly made of glass. I do not myself object to putting electric insulators, whatever they may be, in the second class. In America they make glass insulators, but in this country earthenware insulators are always used for telegraph work, and they are packed in casks.

Lord BALFOUR of BURLEIGH: If you put in the words telegraph insulators, might it not come under the class of insulators in class

2; and would not the makers of electric insulators, which you say are glass, claim to come under telegraph insulators?

Mr. A. TROTTER: Glass insulators are not used in this country by reason of the climate. They are used in America and in dry countries; but in this country the insulators are invariably earthenware insulators.

Lord BALFOUR of BURLEIGH: We are not sure of that.

Mr. TROTTER: I am speaking of telegraph insulators as telegraph insulators.

Lord BALFOUR of BURLEIGH: Although they are not used in this country, it may be that they are made in this country and sent elsewhere. That is not a complete answer.

Mr. A. TROTTER: They might be put as electric insulators in another class, but we are objecting not to telegraph insulators.

Lord BALFOUR of BURLEIGH: Yes, and I ask you whether any maker of electric insulators made of glass, which you admit to be a special article and different from your own earthenware article, might not come under what you are now asking for, to which you replied that they are not made in this country, and I told you that it was not a complete answer, because they might be made in this country and sent elsewhere.

Mr. A. TROTTER: We should have no objection to have telegraph insulators, not glass packed. That would satisfy the conditions.

Lord BALFOUR of BURLEIGH then asked the railway company's representative what they had to say on the subject.

Mr. HARRISON: What we know as telegraph insulators are the small earthenware blocks.

Lord BALFOUR of BURLEIGH: Where do you claim that they go at the present time?

Mr. HARRISON: They would go probably as earthenware.

Lord BALFOUR of BURLEIGH: Have you any objection to its being made clear that electric insulators are different from telegraph insulators, not glass packed?

Mr. BEALE: Telegraph insulators, earthenware, packed, would come under class 1.

Mr. TROTTER: Telegraph insulators, earthenware, packed would do.

The Court then proceeded with the consideration of other articles.

LEGAL.

Automatic Electric Supply Shares.—On Friday the case of Williamson *v.* Armstrong came on in the Lord Mayor's Court, before Mr. Hopwood, Q.C., sitting as Deputy-Judge, by way of demurrer. The action was brought on the Equity side of the Court by Mr. A. Williamson, Mr. W. A. Smithe, and Mr. William Morris, stockbrokers, 53, Wool Exchange, E.C., against Mr. G. P. Armstrong, of Suffolk House, Laurence Pountney Lane, E.C., to enforce the specific performance by the defendant of a contract to buy 300 £1 fully paid-up shares in the Automatic Electric Supply Company, Limited. To this the defendant demurred, on the ground that the circumstances did not disclose any equity; and the case now came on for argument.

Mr. T. T. Fillan was counsel for the demurrer (the defendant), and Mr. Rockingham Gill appeared on behalf of the plaintiff.

Mr. Fillan said that, in the month of August, 1889, one Arthur Quick was possessed of 300 fully-paid £1 shares in the Automatic Electric Supply Company, Limited, which he had purchased from the defendant. A condition of the sale was that the present defendant should buy them back within a month if Quick desired it. On the 31st December Quick sold the shares to the plaintiffs, together with all the rights accruing to them, and it was now sought to make the defendant buy the shares back in accordance with the agreement entered into with Quick. His (Mr. Fillan's) contention was that under those circumstances there was no equity.

The learned judge said it appeared to him that a simpler way would have been to have sued the defendant for damages after selling against him in the market.

Mr. Gill said that what was wanted was to obtain specific performance, and to put the defendant's name on the list of shareholders.

A lengthy argument ensued, and in the end the judge decided that there was nothing upon which he could use the power of the Court to make the defendant take the shares, and the demurrer would therefore be allowed with costs.

Liberty was granted to the plaintiff to apply to amend the pleadings within 14 days.

International Cable Company.—A petition for the winding up of this company was set down for hearing before Mr. Justice Stirling last Saturday. Mr. Buckley, Q.C., asked for the appointment of an examiner to examine certain witnesses in France and Portugal. His Lordship, on reviewing the facts, could not see that the commission would effect any good if granted. It was arranged that the hearing of the petition should stand over until next Saturday.

NEW PATENTS—1890.

5645. "Improvements in electric railway apparatus." J. B. ODELL. Dated April 14. (*Complete.*)

5678. "Improvements in electric tension regulators or apparatus for automatically controlling or regulating electric currents." J. KALB. Dated April 15.

5716. "Improvements in the method of and means for producing low tension alternating electric currents and applying the same to sundry purposes." E. MANVILLE and W. L. MADGEN. Dated April 15.

5728. "Improvements in apparatus for regulating the speed of dynamo-electric and other machines." H. H. LAKE. (Communicated by T. M. Foote, United States.) Dated April 15. (*Complete.*)

5750. "Improvements in armatures for dynamo-electric machines and electric motors." R. E. B. CROMPTON. (Partly communicated by W. Fritsche, Germany.) Dated April 16.

5764. "Improved system of electrical inter-communication, and apparatus applicable for use therewith." W. P. THOMPSON. (Communicated by A. W. Berne and B. W. Taylor, United States.) Dated April 16. (*Complete.*)

5836. "Improvements in apparatus for automatically controlling and regulating dynamo-electric machines and motors." J. RADCLIFFE. Dated April 17.

5910. "Improved method of and means for insulating electrical conductors, especially applicable to high tension currents." A. J. JARMAN. Dated April 19.

5923. "An improved electric servo-motor." C. W. SLEEMAN. Dated April 19.

5925. "Improvements in telephony." M. G. KELLOGG. Dated April 19.

5926. "Machine for covering electrical conductors and cables with lead." S. PITT. (Communicated by J. B. Atherton, United States.) Dated April 19.

5942. "Improvements in the construction of electrical vent-sealing tubes for firing ordnance and like purposes." H. C. L. HOLDEN. Dated April 19.

5951. "Telephone slide index." W. C. FLETCHER and D. CRAVEN. Dated April 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1889.

2003. "Improvements in electric regulating apparatus for use in connection with steam engines and other motors and dynamo-electric machines." A. L. SHEPARD. Dated February 4. 8d. 1. A regulating apparatus comprising an electro-motor arranged to operate a valve for controlling the distribution of fluid under pressure to a cylinder, the piston of which is connected with a throttle valve or other regulating device, for the purposes specified. 2. The improved apparatus constructed substantially as described with reference to the drawing and operating in the manner and for the purpose specified.

2205. "China or porcelain cap or socket for incandescent electric lamps." E. W. LANCASTER. Dated February 7. 6d. Consists in making the caps or sockets for incandescent lamps of china, porcelain or earthenware, instead of vitrite or metal and plaster, as usually employed. 3 claims.

3580. "An improved electric bell or gong." F. H. BERRY. Dated February 28. 6d. The inventor mounts on a suitable base a coil of insulated wire, and at one end of the framing, in which this coil is mounted, is secured one end of a thin sheet of metal which forms a spring and extends along parallel, or thereabouts, with the coil, the free end thereof touching a contact pillar erected on the base. On the side of this spring is secured the hammer, the end whereof can strike a stud or projection on the inner side of the bell or gong, which, in this style, covers this whole apparatus, or the hammer can strike any suitable bell or gong in any manner. 4 claims.

4192. "A new or improved regulator for transformed electric currents." SIEMENS BROS. & Co. (Communicated from abroad by A. M. Taylor, of India.) Dated March 9th. 6d. Claim:—A regulator for transformed electric currents, consisting of a two-limbed solenoid made in horseshoe form and suspended by an adjustable spring, with the ends of its cores presented towards a stationary armature, the one core having its coil in the main secondary circuit, and the other core having its coil of a greater number of convolutions in a long shunt from the secondary circuit, substantially as described.

16144. "An improved electric tell-tale apparatus." H. HAYMAN. (Communicated from abroad by A. Gundersen, of New Zealand.) Dated October 14. 6d. Relates to a new and improved tell-tale clock more especially applicable for use on board ship, but which is also applicable for use in warehouses and other buildings wherein watchmen are employed. The said invention has for its object to indicate and register at any given time the presence of watchmen or look-out men at their posts. 3 claims.

16662. "Improvements in moulds for casting the plates of secondary or storage batteries." W. SHAPLEIGH. Dated October 22. 8d. Consists of a mould constructed so as to be rapidly filled from the bottom in an upward direction, thereby permitting air to escape from the top of the series of matrices of the mould through preferably knife-edge channels communicating with larger channels. The material or substance is introduced through a funnel-shaped feed channel communicating with oppositely disposed risers and through knife-edge channels into the two series of matrices of the mould. The knife-edge channels by preference near the upper ends of the respective matrices are enlarged in order that as the material or substance becoming cast into plates therein cools and contracts they may suck in sufficient material from the risers to fill up any space that may have been formed by the contraction of the series of plates. Between the series of matrices the horizontal channels for the escape of air communicates with vertical main air channels located on each side of the matrices of the mould and extending to the top of the mould. 2 claims.

17765. "Improvements in electro-magnetic dispatch apparatus." H. J. HADDON. Dated November 7. 6d. Relates to electro-magnetic apparatus which is intended for the transportation of letters and packages. 2 claims.

18004. "Improvements in incandescent electric lamps." R. A. SLOAN. (A communication from abroad by G. W. Wilson and C. H. Brown.) Dated November 12. 6d. Consists of a hollow reflector located between the limbs of the filament and composed of transparent non-conducting material, such as glass, whereby the rays of light are not only reflected from the convex surface of the reflector but are also reflected and distributed from the interior concave surface of the said reflector Further the invention consists in colouring or tinging the reflector whereby the reflected light is coloured and given a distinctive character, and, finally, the invention consists in filling the tubular reflector with crystals, such as iodide of lead or other suitable material. 2 claims.

18979. "Improved regulator for electric currents." W. R. MICHL. Dated November 26. 6d. Has for its object to provide a self-acting regulator for electric currents. 1 claim.

19216. "Improvements relating to the generation, distribution, and utilisation of electrical currents." F. J. PATTEN. Dated November 29. 8d. Consists of particular methods of operation and apparatus. 22 claims.

19484. "Improvements in electrical switches, specially applicable for electric vehicles fitted with two motors." F. V. ANDERSEN. Dated December 4. 8d. Relates to electrical switches specially applicable for electric vehicles, relates to that class of switch employed for turning on the electric current to two electric motors serving to propel a vehicle, and has for its object to construct the switch in such manner that the desirable combinations of the two motors can readily be obtained to give suitable driving powers for varying loads and speeds. 1 claim.

19899. "Improvements in or relating to electric batteries." W. P. THOMPSON. (A communication from abroad by M. W. Parrish, of America.) Dated December 10. 6d. Has for its object the production of a primary battery in which graphite in its natural or crude state is used as one of the polar elements of the battery, and in which zinc is preferably used as the other polar element, and salt and water is preferably used as the solution. 2 claims.

CORRESPONDENCE.

Electrification.

Perhaps one of your numerous readers would be good enough to afford me some information on the following points:—

A. Given a certain length of insulated conductor, and given a battery divided into groups of, say, 50, 100, 150 and 200 cells, so that the E.M.F. could be increased by 50 cells at a time, and supposing that (1) at the expiration of one minute's electrification with 50 cells, the 100 cells were instantaneously applied without putting the cable to earth; that (2) after one minute's electrification with 100 cells the 150 were applied, the cable ends having still remained insulated; and that (3) after one minute's electrification with 150 cells, the 200 were applied under the same conditions and kept on the cable during one minute; what deflections, as compared with one another, ought we to expect at the expiration of one minute's electrification in each case?

B. Presuming that my question as to the deflections is replied to, and that a rule is given for one's guidance as to what proportion these deflections should bear to one another, I would further inquire as to the basis upon which such a rule is framed, and what law, governing the action of electricity, is involved?

Inquirer.

The Microbe of the Magnet.

I send you herewith a newspaper cutting which contains what purports to be an extract from the ELECTRICAL REVIEW.

I hope you never wrote such awful rot.

R. A. Currie.

Kiukiang, China, *March 11th*, 1890.

THE MICROBE OF THE MAGNET.

With all the paraphernalia of the modern physical and electrical laboratory, the instruments of precision that will handle a millionth of an inch as readily as a labourer his pick or shovel, with all the evolution going on through generations of scientists, and the almost incessant wresting of secrets from the bosom of nature, we doubt if science is any closer to the isolation or attenuation of the microbe of the magnet. It is absurd to suppose that a primary energy is impressed upon a piece of hardened steel once for all. The transfer of that energy into actual work would quickly destroy the magnetic power, yet such destruction not only does not take place, but the very exercise of the power strengthens the magnet.

A horseshoe of steel can be magnetised in ten seconds by the current of a few ampères from a battery, a ridiculously small amount of energy all told, and such magnet can lift many pounds of iron in contact. But without contact, it may lift and hold a pound of iron easily. It will hold that pound for an eternity, and every second of that time without end the magnet is expending energy, until it foots up an almost inconceivable total of actual power. Not alone that, but the magnet of one pound lifting power to-day may, and will, be stronger to-morrow. Where does all this really tremendous amount of energy come from?

By what inscrutable process does the mere magnetisation of a bar of steel make of it a machine for the transformation of energy? Not a reactionary or storage device which, like a steel spring, honestly gives back approximately all it has received, but a perpetual transforming or converting machine. There is a hidden process going on of some kind; energy is going into the magnet all the time it is doing work—energy in some form. Where does it come from—gravity; atmosphere; solar rays; earth currents? Who can say. It is a great problem, worthy of a lifetime of indefatigable research. *It is a microbe, and it will be discovered*, and the discovery will make electricity the queen of nature's forces, and steam will become a dim vision of the dark ages of the past.—*The Electrical Review.*

[We did not. The extract is probably from our New York namesake, and we ask newspaper writers, in justice to ourselves, to make the distinction between us when using the paste and scissors.—EDS. ELEC. REV.]

Another Probable Litigation.

It is to be expected that some lively revelations as to the way of conducting business will shortly be made known in a legal action which is about to take place between an electrical company and a well-known electrical firm. The latter undertook the management of a very important scheme, and after having ousted the inventor from the company and spent thousands of pounds, they finally succeeded in bringing the whole concern to an utter failure. Not being able to find anything more plausible to account for their incapacity they laid the blame on the system and coolly begged to submit one of their own.

Loco.

Electrotyping.

Lately I have been conducting some experiments with a dynamo used for electrotyping work. An acid solution has been used in the bath with a rocking motion, and I have been able to deposit thoroughly good copper with a current density of 20 ampères per square foot. If any of your correspondents can favour me with a practical method of increasing the current rate per square foot, I shall feel extremely obliged.

Reginald J. Jones.

April 29th, 1890.